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The Effect of Medicaid and Private Fees on Physician Participation in California's Medicaid Program, 1974 - 1978

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I. INTRODUCTION AND OVERVIEW

This study analyzes the effect of a major change in physician reimbursement levels in the California Medicaid program, a public medical insurance program which covers the state's 3.2 million poor, disabled, and medically needy persons. Econometric techniques are employed to disentangle the effect of changes in fees from other factors, principally changes over the period in the number and mix of Medicaid eligibles and the number of physicians actively practicing in the state. Individual physician (micro) data are employed for the analyses and the effect of both private prices and Medicaid reimbursement rates on the supply of physician services to the Medicaid program are estimated.

The analysis of this paper focuses on the period of 1974-1978. During the initial three years, 1974-1976, physician fees were based on a usual, customary and reasonable (UCR) charge system developed with 1968 physician billings for individual procedures. The only change in allowed fees for the 1968 to 1976 period was a 2.5 percent increase in 1972. In September 1976, California changed its reimbursement system to a uniform statewide fee schedule; i.e., all physicians were paid the same rate for identical procedures regardless of their individual billings. The fee schedule adopted was based on the average rate the Medicaid program was paying for each procedure, thus eliminating all the interphysician differences in fees that a UCR system normally permits. The state then applied rate increases to each procedure. On average, the new schedule reflected a 30 percent increase for maternity care services, a 20 percent increase for primary care services and a 65 percent increase for anesthesia services. All other services received an increase of 9.5 percent. Thus fees were not only increased but relative fees were "twisted" in a fashion which favored particular procedures. Following this one time fee increase in 1976, reimbursement rates (with one exception) have remained constant for the remainder of the study period. The exception was a 7.7 percent increase in pathology fees in 1977.

Manipulation of physician fees has become an important policy tool employed by states in their efforts to control Medicaid costs. Because of the complexity of Medicaid law and regulations, states choices of policies to control cost escalation are limited. Physician payment policy, however, is a matter of considerable state discretion and states have responded with substantial control over rates. Thus, the California policy is far from atypical. States such as New York, Massachusetts, Pennsylvania, Connecticut, Illinois, Ohio and New Jersey have kept Medicaid fees either constant for long periods of time or well below private physicians fees. The implications of these physician fee policies for access, use, and cost of services have not been well understood. The primary purpose of this research is to provide the analysis needed to assess the effects of these policies.

As part of this analysis, two subsidiary issues are addressed. First, how do physicians respond to increases in Medicaid eligibility aside from the issue of a change in Medicaid fees. One would expect that if there is excess demand for Medicaid patients prior to the eligibility change, as many suspect exists in low Medicaid physician fee states, new Medicaid eligibles would have a very difficult time gaining access to a private physician, i.e., if there are Medicaid patients already not receiving the medical care demanded, then additional patients will just add to the length of the lines to see private physicians.

During the period of analysis, California had several changes in eligibility which lead to substantial increases in the number of Medicaid eligibles. The primary change occurred on July 1, 1976 when the California legislature passed a bill simplifying the process of determining eligibililty for the medically needy and the medically indigent. The medically needy are individuals who meet the categorical requirements but whose incomes are too high for public assistance eligibility. The medically indigent have low incomes but do not meet the categorical requirements for public assistance eligibility. Different eligibility requirements for these two categories of eligibles were thought to lead to administrative errors, high administrative costs and inequities in treatment of the poor. The net effect of the new legislation was to make the two programs equivalent in terms of financial requirements and to make it somewhat easier to become and remain eligible.* The result was a substantial increase in medically needy and medically indigent eligibility between 1976 and 1977. Medically needy eligibility increased by 60.8 percent between 1976 and 1977 and medically indigent eligibility by 50.8 percent. For the five year period on which this analysis focuses, the medically needy increased by 148.6 percent and the medically indigent by 119.8 percent. The number of persons in the AFDC program increased by about 12 percent over the same period. The total Medi-Cal non-aged population increased at an annual compound rate of 8.0 percent for a total of 36 percent between 1974 and 1978. Consequently, during most of this period, the absolute size of the non-Medicaid program was decreasing, i.e., the number of persons with private, Medicare or no insurance was decreasing. In effect, the rate of transfer to the Medicaid population from the general population exceeded the rate of growth in the general population.

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*John Holahan, Margaret Sulvetta, William Scanlon, "Medical Fee Controls and Physician Behavior: Preliminary Evidence from California" Working Paper, The Urban Instutute, Washington, D.C., March, 1981.

The second subsidiary issue addressed by this study is the effect of an increasing supply of physicians on doctors willingness to treat Medicaid patients. During the period of this study, the total physician supply in California, like the rest of the U.S., increased in absolute terms and relative to the increase in population. The numbers of internists and pediatricians increased most significantly. The ratio of internists to population increased by 20.3 percent and the ratio of pediatricians to population by 22.2 percent. As the physician supply increased relative to the number of private paying patients, one would expect that physicians would become more willing to treat Medicaid patients.

The issue of increased physician participation in Medicaid as a consequence of changes in the supply of physicians is of significant policy relevance as the number of physicians grows substantially in the coming years. By 1990, it is projected that there will be close to 600,000 active physicians and osteopaths as compared with 323,000 in 1978, a 5.3 percent compound annual rate of growth.* Adjusting for projected changes in the population, this will mean that in the same period, the number of persons per physician will fall from 578 to 409 representing a compound annual rate of decline of 2.8 percent. One potential consequence of this increased physician supply is that total Medicaid expenditures may increase even if fees are strictly limited or reduced because, as the supply increases, physicians may be more willing to treat Medicaid beneficiaries. Viewed from a different perspective, states could achieve the same access or utilization objectives with lower physician fees than would otherwise be the case because of the increasing supply of physicians. The growth in physicians per capita will permit Medicaid agencies in California and elsewhere to purchase a given level of services with lower rates of payment.

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*U.S. Department of Health, Education and Welfare, A Report to the President and Congress on the Status of Health Professions Personnel in the United States, August 1978, p. 11-30.

An earlier paper, based on the same data, which did not include formal hypothesis testing, reported the following information.* Between 1974 and 1976, total payments to the sample of 5000 physicians grew substantially despite the constant Medicaid fee level for this period. Increases in gross payments from Medicaid were over sixty percent for pediatricians and over thirty percent for three other specialties. At the same time payments were much less than if the program had paid physicians at their billed rates, i.e., the Medicaid fees were less than private fees. Total payments to sample physicians increased for several reasons. First, there was a substantial growth in the number of Medicaid eligibles. Second, reimbursement rates for several specialties increased as the procedures billed by physicians became more complex. For example, fee indices, which reflect changes in the composition of services provided, increased from 1974 to 1976 by 11 percent for general practitioners, 14 percent for general surgeons and 20 percent for pediatricians. Third, participation rates, defined as treating one or more patients per quarter, increased for six of seven specialties (all but obstetrician-gynecologists). Fourth, patients treated per physician increased for six of seven specialties. (all but internists). Fifth, the number of services per patient (as distinct from more complex billing per patient) increased for four specialties and declined only slightly for the other three.

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*John Holahan, Margaret Sulvetta and William Scanlon, "Medicaid Fee Controls and Physician Behavior: Preliminary Evidence from California," The Urban Institute Working Paper, March, 1981.

It appears then that extremely stringent fee controls during the period 1974 to 1976 did not reduce willingness to treat Medicaid patients. There are several possible explanations. There may have been a reduction in private demand per physician due to the recession in 1974-1975 and because of the shrinking size of the non-Medicaid population. The coupling of an increasing supply of physicians with fewer private pay patients could result in a reduction in private demand per physician. The result would be an increase in office capacity to treat additional Medicaid patients at just the same time as Medicaid eligibility increased the number of persons able to demand care through the program. Nonetheless, physicians in all likelihood would not be willing to treat Medicaid patients unless Medicaid rates were high enough. It appears then that Medicaid rates exceed the marginal costs of providing services at least for many physicians. There also appears to be an increase in the number of physicians organizing their practicies to treat large numbers of Medicaid patients.*

After Medicaid fee increases in 1976, gross participation rates in the Medicaid program showed slight decline for four of the seven specialties when using a definition of one or more Medicaid patients per quarter. Since this definition of participation includes many physicians who see a few Medicaid patients, a slight decline in participation may not be surprising. The number of distinct Medicaid patients per physician is more likely to be sensitive to fees and this ratio showed substantial increases in the period after the fee schedule increase. Increases in the number of distinct Medicaid patients per physician were particularly large for the primary care physicians for whom fee schedule increases were the largest. Over the period 1977 to 1978, patients per physician increased by 37.5 percent for pediatricians, 36.4 percent for obstetricians, 23.4 percent for internists and 23.2 percent for general practitioners. Since the increase in Medicaid eligibility during this period was 12.8 percent not all of the increase in patients per physician can be attributed to the increase in fees. Some of the increase in patients was offset by a decline in services per patient. On balance, however, Medicaid services per physician increased in the period after the fee increase.

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*_Ibid_.

In 1978, participation rates, patients per physician, and services per patient all generally declined. Nonetheless, participating physicians saw many more patients in 1978 than they did before the increase in the Medicaid fee schedule.

In sum, the increase in California Medicaid physician fees, coupled with a twisting of relative fees in favor of primary care, appears to have had the expected results of increasing both physician participation and the total amount of Medicaid care supplied. Primary care physicians dramatically increased the number of Medicaid patients they treated after the fee schedule increase. One year later, after fees were again frozen, patients per physician declined but remained above levels prior to the fee schedule increase. Clearly the fee increase was not hte sole factor to affect physician behavior during the study period. Since the preliminary analysis used univariate techniques, if was not possible to identify the effects of separate forces. We believe that increases in private prices, Medicaid eligibility and the supply of physicians had major influences which should be identified.

In this paper we use econometric techniques to analyze the effects of changes in reimbursement policy, Medicaid eligibility, the supply of physicians, private prices, and other factors on physicians' response to the

Medicaid program. The results, for solo practice physicians, can be briefly summarized:

1. Higher (lower) Medicaid fees increase (decrease) physician willingness to participate and supply services to the Medicaid program other things being equal. The universal Medicaid fee levels adopted in California in late 1976 led to both more physician participation in the program and more services supplied than would otherwise be the case. However, the large increase in supply of Medicaid services came predominantly from participating physicians increasing their output rather than from higher participation rates.

   While the number of physicians participating increases with increases in Medicaid fees, in Medicaid eligibility, and in the number of physicians per private patient, the rapid rise in private demand (prices) has been more than enough to offset the other three influences. Consequently, the net effect of the four factors was a substantial downward pressure on the probability of participation in Medicaid. This does not say that the Medicaid fee increases had no effect. It merely notes that the rapid rise in private prices had a substantially offsetting influence between 1974 and 1978. While there was downward pressure on the likelihood of participating in Medicaid it should be noted that the pool of physicians was increasing dramatically in this time period. This implies that a declining participation rate would not necessarily imply a declining population of physicians willing to provide Medicaid services.

2. When the change in supply of Medicaid services is decomposed into three component parts: total services (measured in RVUs) per physician, RVUs per patient, and the number of different patients per physician, the following is observed:

   a. With increased Medicaid fees, total RVUs per physician increase with a Medicaid price elasticity of 0.2 to 0.4 for primary care physicians and 0.6 to 0.8 for surgeons. These elasticity estimates reflect the total effect of both the direct stimulus of the Medicaid price increase on physician supply and the opposing indirect effect which operates through private price changes. Because the increase in Medicaid fees represents an upward shift in overall demand, physicians raise their private prices. As Medicare and private insurance holders adjust to the higher prices, non-Medicaid demand rises, partially offsetting the effect of the Medicaid fee increase. The magnitude of the indirect effect is not known with certainty but a reasonable estimate is approximately 30 to 60 percent of the direct effect, i.e., a substantial part of the effect of changes in Medicaid price on the Medicaid program is dissapated by the likely adjustment of the private market to the increase in Medicaid prices.

      The estimated elasticity of total Medicaid RVUs with respect to private price for both primary care and surgery is -0.45. The elasticity for patients per physician is similar in magnitude and sign. The private price elasticity of participation in Medicaid was -0.90 for both specialty groups. In essence, physicians' supply of Medicaid services is responsive to changes in private price. Hence Medicaid policies should focus on both Medicaid and private price.

Over the entire five year period, 1974-1978, private prices rose 35 percent while Medicaid prices were raised 20 percent for primary care and 10 percent for surgery. On balance then, the increases in Medicaid price were not sufficient to offset the changes in private price. For primary care the net effect of these two price changes, in the long run, is to decrease total Medicaid RVUs per physician approximately 17 percent. For surgery the decrease is approximately 9 percent. These estimates reflect our best judgment regarding the magnitude of the indirect effect of Medicaid prices on private price.

To provide some insight into the importance of the indirect effect we note that if we were to assume that the indirect effect of Medicaid price increases on private demand were zero, the decrease in total Medicaid RVUs would have been 5 percent for primary care and 6 percent for surgery.

In conclusion, the Medicaid price increase in 1976 was substantial and clearly had strong results on physician response to the Medicaid Program. However, on balance, the change was not sufficient to totally offset the effects of the rapid rise in private prices. (See below for the net effect of other changes occuring during this period).

b. Increases in Medicaid prices lead to substantial increases in the number of different Medicaid patients seen per physician with Medicaid price elasticities in the range of 0.24 to 0.90 for primary care physicians and 0.95 to 1.14 for surgeons. These estimates are for the total effect of Medicaid price, i.e., they are the net of the direct and indirect effect of Medicaid price on physician behavior.

3. The effect of the increase in the physician supply is to make primary care physicians more willing than they would otherwise be to supply services to the Medicaid program. The elasticity of supply to Medicaid was estimated to be fairly elastic with point estimates of 0.8 to 1.10 for total RVUs and 0.4 for Medicaid patients per physician.

   Quantitively, the effect of the change in the physician supply over the period 1974 to 1978 has been reasonably large. For example, over the entire five year period, the change in the physician supply led, other things equal, to the average primary care physician treating 5 percent more Medicaid patients and supplying 15 percent more total RVUs to Medicaid. For surgery, however, the change in the physician supply had very small effects on the supply of Medicaid services.

4. The change in Medicaid eligibility also induced physicians to supply more services to the Medicaid program. The point estimate of the effect of Medicaid eligibility on physician Medicaid supply was approximately 0.5 for both primary care and surgeons for both the total number of RVUs and the number of patients per physician. Over the five year period of this study, Medicaid eligibles per physician increased approximately 15 percent which lead to an increase of 7 percent of total RVUs per physician for both primary care and surgery.

5. An overview of the quantitative effects of the four parameters of interest in this study (private and Medicaid prices, Medicaid eligibles per physician and physicians per private patient) shows that net effect per physician participating in Medicaid, was to increase total RVUs 9 percent for primary care and a net decrease of 2 percent for surgery.

6. Quantitatively, these results clearly show that physicians the respond predictably to changes in Medicaid fees. Consequently, the setting of Medicaid fees, in terms of both their absolute level and, differentials among procedures, offers a substantial policy instrument for affecting the direction and cost of the Medicaid program. Finally, the increasing supply of physicians is also having predictable effects on physician behavior and while this factor is not a ready policy instrument, the predicted growth in the supply of physician presents cost saving opportunities to state Medicaid programs.

II. THEORY

Several researchers have successfully applied the theory of the price discriminating firm to the analysis of physicians participation in Medicaid.* This discussion will follow and extend it slightly. The price discrimination model is used because the physician receives different reimbursements from Medicaid and private patients for the same services even though a single price is charged. A physician's practice is seen as a monopolistically competitive firm which sells services in two or more markets. In the first market, consisting for simplicity of all non-Medicaid patients, individuals purchase services according to a downward sloping demand schedule. The other market consists of Medicaid patients and is represented by infinitely elastic demand curves set at fixed fee levels. (Individuals in other insurance plans such as Medicare assigned patients and fully covered Blue Shield patients could be represented in the same way). Service production is represented by the usual shaped cost curve with increasing marginal costs over the relevant range.

The model can be described through the use of the Figure II-1 below.

Let Q = total services provided by a physician

Q_p = services provided by physician to private patients

P = price charged per service to private patients

P_m = Medicaid fee level

MR = marginal revenue function

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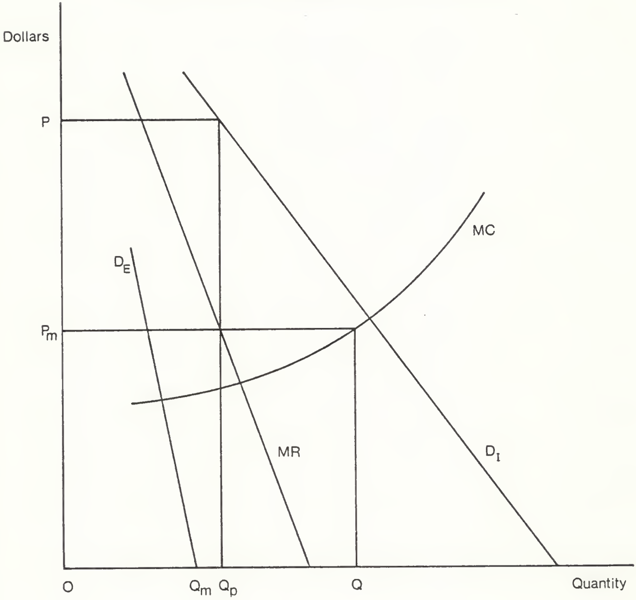
*Hadley J., "Physician Participation in Medicaid: Evidence from California," Health Services Research 14 (1979):266-80; Sloan F. and Steinwald B., "Physician Participation in Health Insurance Plans: Evidence from Blue Shield," Journal of Human Resources 13:237, Spring 1978; Sloan F., Mitchell J. and Cromwell J., "Physician Participation in State Medicaid Programs," Journal of Human Resources 13 (Supplement 1978):211-245. Held, P., Manheim, L., Wooldridge, J., "Physician Acceptance of Medicaid and Medicare Patients," Mathematic Policy Research, Princeton, N.J., 1977.

Figure 11-1

Physician Supply in the Medicaid and Private Markets



MR = marginal revenue function

MC = marginal cost function

D_E = demand curve for Medicaid eligible patients

D_I = demand curve for all other patients

The demand curve D_I represents the demand for services of a given physician by private patients. The demand curve D_E represents the hypothetical demand curve of Medicaid eligibles had they not been eligible. Because they are indeed eligible and there is no cost sharing in Medicaid, the relevant Medicaid demand facing the physician is represented by the segment $0\ Q_m$, the amount of services Medicaid patients demand at zero price. The theory of the price discriminating firm states that physicians maximize profits by setting marginal revenue equal to marginal cost in both markets.

In Figure 1, the physician provides 0 Q total units of service with $0\ Q_p$ units being provided to private patients at price P. The physician provides the remainder, $(Q - Q_p)$ to Medicaid patients at price p_m. If $0\ Q_m$ Medicaid demand is greater than $(Q - Q_p)$, then there is an excess demand for services by Medicaid recipients; that is, the physician is unwilling or unable to provide all the services Medicaid recipients demand. If $0\ Q_m$ is less than $(Q - Q_p)$, then the physician will be willing to supply more services to Medicaid patients than they demand. Clearly, the amount of service a physician provides to Medicaid patients depends on the amount of non-Medicaid demand, factors affecting physician willingness to supply services such as costs, Medicaid fees, and Medicaid eligibility in a physician's market area.

The model has several implications for Medicaid policy. First, with other things equal, an increase in Medicaid fees will increase the number of services physicians are willing to supply to Medicaid; reduce the number of services supplied to private patients; and raise prices in the private market. In effect, resources are bid toward the public sector. However, increases in the Medicaid fee level will result in an increase in the supply of services to Medicaid only if there is an excess demand for the physician's services at the initial fee level. If there is no Medicaid excess demand and Medicaid fees are increased, an increase in Medicaid utilization will be observed only if physicians take actions to increase Medicaid demand. For example, physicians could reduce access cost to Medicaid patients by reducing appointment or waiting times, or having more office hours perhaps in the evening or on weekends. In such a situation of "excess supply", physicians also have incentives to create demand, perhaps by recommending more frequent visits than a well-informed patient would demand. Similarly if there is excess Medicaid demand, a reduction in Medicaid fees relative to private fees will result in physician's preferring to supply fewer Medicaid services.

If there is no excess Medicaid demand a reduction in Medicaid fees relative to private fees may not affect Medicaid utilization. Although physicians will prefer the new desired to provide fewer Medicaid services, the resulting supply may be adequate to meet existing Medicaid demand.

As noted above, an increase in Medicaid fees will result in higher private prices. Eventually, higher private prices may cause an upward shift in the private demand curve* as both private and non-Medicaid public (Medicare) insurance plans adjust to the higher private prices induced by the increase in Medicaid fees. The extent of the shift depends on how the price of insurance is affected by increases in physicians fees and how the demand (and supply for Medicare) for insurance is affected by increases in price.

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* We use may because the reaction of the private demands to increases in prices brought about by the increase in Medicaid fees is uncertain. It is probably safe to conclude that there will be some adjustment of the private demand function to the increased price. It is also reasonable to suppose that the maximum adjustment would be a shift in the private demand function which just offsets the increased private price.

A second implication of the model is that, an increase in Medicaid eligibility will result in increased utilization only if Medicaid fees are high enough that physicians are willing to treat more patients or provide more services. If excess Medicaid demand already exists, an increase in eligibility will not result in an increase in utilization. Thirdly, the model shows that an upward (downward) shift in private demand will decrease (increase) the quantity of care provided to Medicaid patients, assuming that the Medicaid fee remains constant. For example, an increase in the physician to population ratio has the effect of shifting the demand curve faced by any individual physician downward. Thus, an increase in that ratio will mean that more Medicaid patients will be seen at any given fee level. In addition, any other factor which reduces private demand, e.g., an increase in unemployment or reduction in real income will have the same effect.

A fourth implication of the model is that, a shift upwards in the marginal cost curve (say because of increases in malpractice costs or wage rates), will induce physicians to see fewer Medicaid patients. In fact, Medicaid output will go to zero before the physician raises prices (and presumably reduces quantities) in the private market. If marginal cost intersects marginal revenue above the Medicaid fee, then the physician will see no Medicaid patients.

The empirical analysis tests the hypotheses implicit in the model by focusing on two apsects of physician behavior:

- Whether or not a physician chooses to participate in the Medicaid program and,

- Given that a physician is a participant, how many Medicaid services are supplied?

We can portray these aspects of an individual physician's response to the Medicaid program by formulating two identies which describe a physician's supply of Medicaid Services:

$$\begin{array}{l} \text{Total Supply of} \\ \text{Medicaid Services} \\ \text{for an Individual} \\ \text{Physician} \end{array} = \left[\begin{array}{l} \text{Probability of} \\ \text{Participation} \\ \\ \\ \end{array}\right] \times \left[\begin{array}{l} \text{Total supply of} \\ \text{Medicaid services} \\ \text{given the decision} \\ \text{to participate} \end{array}\right]$$

$$\begin{array}{l} \text{Total Supply of} \\ \text{Medicaid Services} \\ \text{for Participating} \\ \text{Physician} \end{array} = \left[\begin{array}{l} \text{Total number} \\ \text{of Medicaid} \\ \text{patients treated} \end{array}\right] \times \left[\begin{array}{l} \text{Average number of} \\ \text{services per} \\ \text{Medicaid patients} \end{array}\right]$$

Our analysis will pursue these general questions by estimating separate behavioral models for all four quantities on the right hand side of the equations i.e. we will estimate four separate models to explain:

1) the decision of whether or not to participate in the Medicaid program and for *participating physicians*, the following three quantities
2) the total number of RVUs (Relative Value Units) supplied to Medicaid patients in a three month period
3) the number of different Medicaid patients treated in a three month period
4) the average number of RVUs per patient treated

Several hypotheses follow directly from the model:

- Increases in Medicaid fees will increase participation rates and the number of patients per physician.
- Increases in Medicaid fees will have a *direct* effect on Medicaid services in each of the four supply equations (1 to 4 above). Medicaid fee increases will also have an *indirect* effect on Medicaid services. As noted above, increases in Medicaid fees will result in higher private prices. This is likely to lead to a some shift in the private demand function as private insurers and Medicare respond to higher private prices. Increases in private

demand will in turn have a depressing effect on the supply of Medicaid services. The net effect then of increases in Medicaid fees depends on both the direct and indirect effects.

- An increase in the number of physicians relative to the non-Medicaid population will increase the number of services provided to Medicaid patients. This is represented in the model as a reduction in private demand facing each physician that is, a downward or leftward shift in the private demand function. It would therefore affect the supply of Medicaid services through its effect on the private price variable. It can also be assumed to affect the supply of Medicaid services directly. Thus the total effect of a change in physician supply depends on its effect through changing private prices and directly by affecting physicians willingness to treat Medicaid patients.

- Increases in Medicaid eligibility will increase services supplied to Medicaid as long as there are some markets with no excess demand. (The eligibility variable is defined as the number of non-aged eligibles per physician. Aged eligibles are excluded because they are jointly eligible for Medicare which pays prices similar to private market prices. This variable enters directly in each of supply equations).

- The effect of fees on the number of RVU's per patient is somewhat ambiguous. As physicians increase their participation in Medicaid as well increasing as the number of patients treated (i.e., reducing access barriers), the characteristics of patients being treated may change, possibly bringing a more healthy mix of patients into the Medicaid program. Thus, while higher fees should result in more services per patient on a case-mix adjusted basis, changes in patient characteristics could result in fewer services per patient. Thus predictions of the net effect are difficult to make. The case-mix problem is ignored in the following discussion of hypotheses, but is addressed in the presentation of results.

A number of other variables enter each supply equation. Years of experience and specialty control for differences in physicians characteristics. Cost of new housing, wages paid in physicians office and a population density variable control for differences in the costs of inputs used by physicians. Differences in the characteristics of the Medicaid population in the physicians county are captured by variables such as the percent disabled, the percent AFDC and the percent medically needy. The excluded category is composed of the medically indigent and blind.

III. DESCRIPTION OF THE SAMPLE

The analysis presented here is based on physician specific data on provision of Medicaid services in the first calendar quarters of five consecutive years, 1974 to 1978. The unit of observation is a solo practice physician. The sample providers are drawn from the statewide population of those solo, office-based physicians who had Blue Shield identification numbers regardless of whether they filed Medicaid claims. Physicians usually obtain Blue Shield numbers upon licensure, hence this population includes nearly all California physicians. The sample is limited to those doctors who were continuously in practice (whether or not they provided services under Medicaid or Medicare) from 1972 to 1978 and had not changed their location or specialty.

Six specialties were chosen for this analysis: general and family practice, internal medicine, obstetrics-gynecology, general surgery and orthopedic surgery.[1] The four primary care specialties are analyzed separately from the two surgical specialties. The distribution of sample practitioners across specialties is presented in Table III-1.

Fifty percent of the sample doctors are located in metropolitan (large SMSA) areas, 37 percent in urban areas, and the remaining 13 percent in non-metropolitan areas. Comparable statewide figures for 1976 are 75 percent metropolitan, 20 percent urban and 5 percent non-metropolitan. The differences between the two distributions arise from the use of 1972 as the base year for the selection of our sample, and over-sampling in rural areas and in primary care specialties. Six counties are not represented by sample

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[1] For the purposes of this study, general practice and family practice are deemed one specialty.

TABLE III-1

Distribution of Sample Physicians by Specialty

Specialty	Sample Physicians Number	 Percent
Primary Care		
General and Family Practice	997	45.2
Internal Medicine	807	36.5
Obstetrics-Gynecology	208	9.4
Pediatrics	196	8.9
Subtotal	2208	100.0
Surgery		
General Surgery	634	77.3
Orthopedic Surgery	186	22.7
Subtotal	820	100.0

doctors and another 19 counties are represented by fewer than 10 sample members per county. These counties taken together, however, encompass only 4.5% of the state population and less than three per cent of California physicians as is shown in Table III-2. The differences in distribution between our sample physicians and the California (or other) physician population should not severely limit the validity of the results because of the multivariate nature of the analysis and the detail of physician-specific information available.

The data used in this analysis were obtained from Blue Shield of California, the Medicaid carrier for the state. Data from individual patient claims were aggregated and variables suitable for multivariate analysis were created for each physician. Claims submitted on behalf of patients eligible for both Medicare and Medicaid were excluded because these claims are subject to Medicare, rather than Medicaid, reimbursement policies. County-specific information about the area in which each physician practices was then matched to the individual physician records to form the final analysis file.

The physician-specific data includes the average amount billed per RVU, the average amount paid (allowed) by Medicaid, the total number of RVU's provided in the first quarter of each year, and the number of unique patients seen during the same period. If a physician also participated in Medicare his/her Medicare billed and allowed amounts per RVU are also available. A specialty code, PSRO location, county identifier and date of medical school graduation are available for all physicians regardless of their participation status in Medicaid and Medicare.

The county-specific data includes information on the Medicaid eligibility, employment status, age and racial composition, and density of the county population; measures of per capita income, average new house values and

TABLE III-2

Comparison of Resident Population and Number of Non-federal Physicians in "Poorly Represented" Counties to California Totals, 1974 and 1978

Location	1974		1978	
	Non-federal Physicians	Population (thousands)	Non-federal Physicians	Population (thousands)
Counties with no sample physicians[1]/	84	124.83	107	139.47
Counties with 1-9 sample physicians[2]/	1164	798.50	1410	808.85
Subtotal	1,248	923.33	1,517	1,020.32
California Total[3]/	44,093	20,963.5	52,194	22,141.9
"Poorly Represented"[4] Counties - Percent of California Total	2.83%	4.40%	2.91%	4.61%

Notes:
1. 6 counties fall in this category.
2. 19 counties fall in this category.
3. California has 58 counties.
4. "Poorly Represented" means that the UI sample of physicians had a small number of observations in that county.

physician's office employee salaries; and counts of the number and specialty distribution of physicians in the county. Complete definitions, sources and summary statistics for these variables are given in Chapter IV.

IV. EMPIRICAL RESULTS

A. Introduction

In this section, we present the results of empirical analyses which test the theory and hypotheses developed above in Section II. Physicians were grouped by specialty into two broad classifications: primary care and surgery, and separate sets of equations were estimated for each. Primary care includes general and family practice, pediatrics, internal medicine, and obstetrics and gynecology. Surgery includes general and ortheopedic surgery. We aggregate across procedures by employing the relative value units (RVUs) of the 1969 and 1974 California Relative Value Scale, the system used by California Medicaid for provider reimbursement.

For the analysis, we employ two estimation techniques, using the same general set of explanatory variables. The individual physician is the unit of analysis. First, we use probit estimation to explain the decision whether or not to participate in Medicaid (output measure 1 in Section II above) and a linear regression model to explain the three supply decisions for participants (the second through the fourth supply quantity described in Section II above). Probit is preferred to linear regression in the first instance because the model employs a binary dependent variable to describe the participation decision; i.e., yes or no. The analysis of the Medicaid services supplied by participants (the latter three quantities to be estimated) however, employs continuous dependent variables and therefore the supporting assumptions of linear regression are more nearly correct. The probit will be of the form:

(1) Participation = P (Prices, Physician Characteristics, Area Characteristics)

The linear regression model to describe the supply of Medicaid services given participation is:

(2) Medicaid Output = O (Prices, Physician Characteristics, Area Characteristics)

These models will take the form:

(3) $$y = a_0 + b_1x_1 + b_2x_2 + \ldots b_i\ x_i$$

A problem with the estimation of both (2) and (3) is that the prices physicians set for their own services (measured in $'s per RVU) is endogenous in that it is likely to be jointly determined with the decision regarding the amount of Medicaid services to supply and presents a problem commonly referred to as simultaneous equation bias. Consequently, we will use an instrumental variable technique to derive unbiased estimates for the coefficient on physician's own price.

Other statistical problems of the estimation of (2) and (3) include the potential serial correlation of observations which derive from the panel nature of the data (a series of observations for the same sample over time) in that some physicians appear in the file in more than one year. This and other econometric problems are discussed in more detail an Appendix B below.

Finally, analysis of the decision to participate requires a definition of participation. At first glance, one might suggest that having treated one or more Medicaid patients in a given time period would constitute participation. However, Hadley* among others, have argued that even non-participating physicians may see a few Medicaid patients (e.g. due to an emergency) and the definition of 1 or more Medicaid patients is not restrictive enough.* There is no ideal method for determining an answer to this issue but like Hadley we tend to prefer 10 or more different Medicaid patients per quarter. Our definition of 10 or more Medicaid patients, while somewhat arbitrary, is based on sensitivity analysis discussed below.

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* Jack Hadley, "Physician Participation in Medicaid: Evidence from California," Health Services Research 14(Winter 1979):266-80.

B. Results

1. Introduction

The location of the specific empirical estimates is shown in Table IV-1. Definitions and basic statistics for the dependent and independent variables are provided in Tables IV-2 and IV-3 respectively. The reader not interested in the technical results may want to focus only on the summary and implication in Sections D and E. (Our discussions of specific coefficient estimates are generally restricted to results where statistical significance level is 0.10 or less).

2. The Decision to Participate

Gross participation rates by year employing different definitions of participation rate are shown in Table IV-4. For example, under a definition of 10 or more patients per quarter, in 1976, 50.4 percent of the primary care physicians were participants. As the definition becomes more stringent i.e., the initial point is set at a higher number of patients per quarter, the participation rate decreases.

There are no obvious trends in these participation rates over time, except possibly to indicate that participation did not appear to fall over the period 1974-1978. For example even in 1977, the first year after the fee schedule change, these "gross" participation rates do not show a distinct

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* One technical problem associated with this definition is that error terms observed for true nonparticipants are always positive.

Table IV-1

Physician Behavior to be Explained, Measures of Behavior, and Location of Empirical Results [a]

Physician Behavior to be Explained	Measure of Behavior	Table and (Equation Number) Physician Specialty Primary Care	Surgery
A. Decision to Participate in Medicaid Program	Yes or No: A Physician Treated More Than 9 Different Medicaid Patients in a Quarter	Table IV-5 Eq.(1)	Table-IV-5 Eq.(2)
B. Medicaid Services Supplied by Physician Participants in One Quarter	1. Total RVUs supplied to Medicaid Patients 2. RVUs per Medicaid Patient 3. Total Distinct Medicaid Patients	Table IV-7 Eqs. (3),(4), and (5)	Table IV-8 Eqs. (6),(7), and (8)

[a] RVU is relative value units. Eq is equation number.

Table IV-2

Definitions and Basic Statistics for Dependent Variables Used in the Analysis[a]

Variable	Acronym	Definition	Mean and (Standard Deviation) Primary Care	Mean and (Standard Deviation) Surgery
1. Total Relative Value Units[b] of Medicaid Services Supplied Per Quarter	TOTRVU	The total number of relative value units (RVUs) provided by the solo practice physician to the Medicaid Program in the 1st quarter of the year. The sample is restricted to physicians with 10 or more Medicaid patients.	4942.68 (8278.50)	3278.62 (3957.58)
2. Average Relative Value Units Per Medicaid Patient Treated	RVUPERPAT	The Ratio of TOTRVU to the total number of different Medicaid Patients seen by the solo practice physician in the 1st quarter of the year. The sample is restricted to physicians with 10 or more Medicaid patients.	59.10 (42.78)	80.82 (51.40)
3. Medicaid Patients Per Participating Physician	PATSPERPHY	The total number of different Medicaid patients seen by the solo practice physician in the 1st quarter of the year. The sample is restricted to physicians with 10 or more Medicaid patients.	93.92 (148.30)	45.64 (62.98)
4. Medicaid Participating Physicians	PARTIC	A binary variable equal to 1 if the physician saw 10 or more Medicaid patients in the 1st quarter of the year. The variable is set to zero otherwise.	0.52 (0.25)	0.50 (0.25)

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[a] The sample is restricted to solo practice physicians in the U.I. sample between 1974 and 1978. Primary Care includes general and family practice, internal medicine, pediatrics, obstetrics and gynecology. Surgery includes general surgery and orthopedic surgery. All data are from the U.I. sample.

[b] California's 1969 Relative Value Scale.

Table IV-3

Definition and Basic Statistics for Independent Variables Used in the Analysis [a]

Variable [b]	Acronym	Definition	Mean and (Standard Deviation) Primary Care	Surgery
A. Reimbursement Prices ($)				
1. Own Billed Amount Per RVU	BILL $/RVU	The price per RVU billed by the solo practice physician to Medicaid programs.	0.84(0.20)	0.92(0.23)
2. Medicaid Allowed Amount Per RVU	ALLOW $/RVU	The price per RVU reimbursed by Medicaid to the solo practice physician.	0.58(0.74E-1)	0.59(0.70E-1)
B. Physician Characteristics				
1. Experience (Years)	EXPER	The number of years between graduation from Medical School and the year in question.	25.32(9.98)	24.94(8.35)
2. Experience Squared	EXPERSQ		740.80(568.85)	691.80(443.50)
3. Specialty binaries				
Internal Medicine	IM	A series of binaries set to 1 if the physician is listed as this specialist. Zero otherwise.	0.30(0.46)	- -
Pediatrics	PED		0.66E-1 (0.25)	- -
Obstetrics Gynecology	OB/GYN		0.11(0.31)	0.25(0.43)
Orthopediatric Surgery	ORTH			
C. County Characteristics				
1. Medicaid Eligibles		Medicaid eligibles per private practice physician and the proportion by category of eligibility.		
a. Non-aged elig./physician			57.41(31.26)	56.08(29.28)
b. Disabled (Proportion)			0.15 (0.26 E-1)	0.15 (0.25 E-1)
c. AFDC (Proportion)			0.60 (0.74 E-1)	0.60 (0.80 E-1)
d. Needy (Proportion			0.11 (0.32 E-1)	0.11 (0.32 E-1)
2. Private Patients		Private practice physicians per non-eligible (Medicaid) person.		
a. Phy/Non Caid Pop.			0.24E-2 (0.12 E-2)	0.25E-2 (0.12 E-2)
b. (Phy/Non Caid Pop.) squared			0.73E-5 (0.97 E-5)	0.76E-5 (0.10 E-4)
3. Cost of Inputs				
a. House Cost			38.62 (15.06)	38.16 (13.82)
b. Wages in Phy. Office			4.47 (3.84)	4.34 (3.56)
c. Population/square mile			13.21E2 (30.23E2)	13.29E2 (32.66E2)
D. Year Binaries 1975			0.21(0.40)	0.22(0.41)
1976			0.20(0.40)	0.20(0.40)
1977			0.21(0.40)	0.21(0.40)
1978			0.20(0.40)	0.20(0.40)

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[a] Sample is restricted to participating physicians only.

[b] All data are from U.I. physician files except as follows:

C1a-d and 2a-b are from California Center for Health Statistics, Data Matters, Sacramento, CA, 1974-1978 and American Medical Association, Physician Distribution and Medicaid Licensure in the U.S., 1974-1978.

C3a is from Security Pacific Bank, California Construction Trends, Los Angeles, California, 1978 and 1974.

C3b is from U.S. Department of Commerce, County Business Patterns, Washington, D.C., 1974-1978.

C3c is from State of California, California Statistical Abstract 1974.

Table IV-4

"Gross" Medicaid Participation Rates for
Different Definitions of Participation,
By Specialty and Year, Solo Practice, California,
1974-1978[a]

Specialty	Definition of Participation	Year 1974	1975	1976	1977	1978
Primary Care	GT 0 Patients	69.7%	73.9%	72.1%	71.3%	68.9%
	GT 9	47.6	52.0	50.4	52.1	48.7
	GT 19	35.4	39.7	38.3	40.2	38.4
Surgery	GT 0 Patients	74.4%	80.6%	77.9%	75.7%	73.9%
	GT 9	43.9	52.3	48.9	50.4	47.4
	GT 19	27.1	32.8	32.3	33.3	31.3

[a] GT is greater than.

indication of an increase in physician participation in the Medicaid program. Again, the only safe statement to be made regarding these aggregate data would be that there does not appear to be a decrease in participation rates over time.

While the aggregate data of Table IV-4 do not show obvious changes in participation rates over time, it would not be correct to assume that physicians did not respond to the increased Medicaid fee schedule. The "gross" participation rate shows the net effect of all the different forces confronting physicians. For example, there could be effects, such as an increase in the demand for services by private pay patients, which might offset the effect of pay schedules on the willingness to participate. To determine the true effect of the Medicaid fee schedule changes on participation, one should use multivariate techniques which will permit the isolation of the various effects. We now turn to our first multivariate results, probit models to describe participation in the Medicaid program.*

The probit results relating to the decision to participate in the Medicaid program, using a definition of 10 or more patients, are shown in Table IV-5.** The sample includes all solo practice physicians, i.e. participants and non participants. We will discuss the results in order.

Price Variables. Both of the price coefficients, the physician's own price per RVU and Medicaid allowed amount per RVU have the expected signs (negative and positive, respectively). For both primary care physicians and

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* See Appendix A below which provides more detail on the characteristics of physicians grouped by participaton patterns.

** For readers unfamiliar with probit estimation, we note that the coefficients are maximum likelihood estimates of an s-shaped nonlinear function and consequently are not easy to interpret directly.

Table IV-5

Probit Estimates of the Decision to Participate in the Medicaid Program, Solo Practice Physicians, California, 1974-1978[a]

Independent Variables	Coefficient Estimates (t statistics)			
	Primary Care		Surgeons	
	(1)		(2)	
A. Prices ($)				
1. Own Billed Amt/RVU	-1.58	(-10.42)	-1.35	(-6.71)
2. Medicaid Allowed Amt/RVU	1.37	(3.97)	3.80	(7.75)
B. Physician Characteristics				
1. Experience (Years)	-0.23E-1	(-3.90)	-0.87	(-0.68)
2. Experience Squared	-0.44E-4	(-0.45)	-0.59E-3	(-2.66)
3. Specialty Binaries				
a. Internal Medicine	-0.44	(-14.52)	—	
b. Pediatrics	-0.17	(-2.81)	—	
c. Obstetrics/Gynecology	0.41	(6.14)	—	
d. Orthopedic Surgery		—	0.99E-1	(1.87)
C. County Characteristics				
1. Medicaid Eligibles				
a. Non-aged elig./physician	0.86	(10.88)	0.97	(7.15)
b. Disabled (Proportion)	2.07	(2.97)	3.15	(2.72)
c. AFDC (Proportion)	-0.35	(-0.94)	-0.47	(-0.76)
d. Needy (Proportion)	1.39	(1.74)	-0.73	(-0.55)
2. Private Patients				
a. Phy./Non-Caid Pop.	-196.3	(-2.60)	-456.2	(-3.60)
b. (Phy/Non-Caid Pop) squared	55.1E3	(4.69)	11.8E4	(6.02)
3. Cost of Inputs				
a. House Cost	-0.81E-3	(-0.64)	-0.44E-2	(-2.05)
b. Wages in Phys. Office	0.16E-1	(3.92)	-0.51E-2	(-0.81)
c. Population/square mile	-9.63E-5	(-5.70)	-0.20E-3	(-7.25)
D. Year Binaries 1975	0.13	(2.85)	0.32	(4.23)
1976	0.27	(4.89)	0.35	(3.97)
1977	0.21	(3.26)	0.23	(2.25)
1978	0.21	(2.90)	0.22	(1.93)
E. Constant	0.74	(1.82)	-0.33	(-0.49)

* * * * * * * * * * * * * * *

	(1)	(2)
Mean of Dependent Variable	0.5110	0.4967
Chi-Sq/n	1178/9931	672.5/3750

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[a] Sample includes participants and non-participants. Participation was defined to be 10 or more patients. Coefficients are maximum likelihood estimates of a standardized index of the probability of participation in the Medical program; i.e., the coefficients are not the partial derivative of the probability itself.

surgeons, higher private prices reduce the likelihood of participation in Medicaid. Similarly, the higher the Medicaid price (allowed amount per RVU), the more likely is a physician to participate in the program. This result is clear indication that "gross" participation rates are inadequate in describing the response of physicians to changes in fee schedules.

Similar results, not shown, in both direction and statistical significance were found using both the participation definition of 1 or more and 20 or more patients. The consistency of these results is reassuring and suggest that the qualitative implications of whether or not physicians respond to both the private and Medicaid price of medical care are robust and independent of the particular definition of participation.

The sensitivity of these results to the choice of definition can be seen from the elasticity estimates shown in Table IV-6, which include the estimates for all three definitions of participation. The results are quite elastic, and show that physicians' participation is quite sensitive to price levels. For both the private and Medicaid price, the elasticities are generally in excess of 0.50.* Only for the definiton of greater than zero patients is the elasticity less than 0.5.

In summary, physician's Medicaid participation decisions are clearly influenced by both the private and Medicaid prices. These results are clearly counter to those reported above for the "gross" rates. The coefficient estimates have very small standard errors, are quite robust regardless of the definition of participation and generally show a high elasticity. While the quantitative estimate of the elasticity does vary with the definition chosen, the basic message to be derived from these results does not depend on the

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* The implications of Medicaid price increases on private prices is discussed in the concluding section.

Table IV-6

Price Elasticities of Participation in Medicaid, California, Solo Practice Physicians By Specialty, 1974-1978[a]

Price (Per RVU)	Specialty	Definition of Medicaid Participation [b]		
		GT 0	GT 9	GT 19
Own Private	Primary Care	-0.28 (4.82)	-1.04 (10.42)	-1.48 (11.37)
	Surgical	-0.50 (7.30)	-0.99 (6.71)	-0.92 (4.42)
Medicaid	Primary Care	0.16 (1.80)	0.60 (3.97)	0.79 (4.02)
	Surgical	1.24 (11.52)	1.79 (7.75)	1.43 (4.31)

[a] Only the direct effect of Medicaid prices on participation is shown. The indirect effect of Medicaid prices on private prices and hence on participation is discussed below.

[b] Participation in terms of different Medicaid patients per quarter. GT is greater than. Asymptotic t statistics for the estimated coefficients on which the elasticities are based are shown in parentheses. No correction for serial correlation among observations has been made.

definition of participation. While our choice is somewhat arbitrary, we prefer the greater than 9 definition of participation and will use this definition for the remainder of our discussion.

We now discuss selected other variables in the participation equation.

Physician Characteristics. The negative coefficients for both variables describing a physician's experience suggests that physician willingness to participate in the Medicaid program decreases continuously with experience, i.e., older physicians are less likely than younger physicians to participate in the Medicaid program, other things equal. By specialty, we observe that relative to GPs, obstetricians and gynecologists (OBGYN) are more likely (than GPs) to participate in Medicaid while internists and pediatricians are less likely to participate, other things being equal. Orthopedic surgeons (ORTH) are more likely, other things equal, than general surgeons to participate in Medicaid.

Medicaid Demand. The coefficients on the measures of Medicaid demand all have plausible signs. First, physician participation increases as the number of non-aged Medicaid eligibles per physician in the physician's county increases.* Similarly, participation increases with increases in the proportion of the Medicaid eligibles who are disabled and decreases as the proportion who are AFDC (Aid for families with dependent children) increases. The signs of the coefficients for the proportion medically needy are positive for primary care physicians but negative for surgeons.

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* We distinguish between the aged and non-aged Medicaid eligibles because the aged eligibles are generally insured by Medicare which implies a different set of prices for the treating physician. The prices for Medicare patients are closely approximate private prices.

The positive coefficients on the non-aged Medicaid eligibles per physician suggest that, at least over the average of this sample, the Medicaid market does not exhibit excess demand. In other words we observe that where there are more Medicaid patients, physicians are more likely to participate in the program, other things including price being equal. Excess demand in the Medicaid market would be consistent with increases in participation as the Medicaid price is increased but excess demand would not be consistent with an increase in participation with increases in the number of eligibles. This result is somewhat surprising, or at least, contradicts the conventional wisdom, which presumes that urban areas with large proportions of Medicaid patients have queues of patients waiting for a physician to provide care. If this were true throughout the State of California, changes in eligibility would not affect participation. We will discuss the implications of this in the concluding section.

The effect of private demand is estimated by the ratio of physicians to the non-Medicaid population in the physicians' county. The functional form is quadratic and the estimated coefficients show that as the number of physicians per private pay patient increases, physicians are more willing to participate in Medicaid other things, including price, being equal.* As discussed in the concluding section, the physician to private patient ratio has been increasing, which implies that physicians are becoming more willing to accept Medicaid patients because of changes in the supply of physicians.

Differences in the costs of production are measured by three variables (HOUSECOST, WAGE, DENSITY). The model specified in Section II above predicts that as the cost of producing services rises, other things including prices equal, participation will decrease. The results are generally consistent with this hypothesis, but the coefficient on the WAGE variable in the primary care equation has the wrong sign.* These results suggest that a uniform fee schedule across the state may lead to lower physician participation in Medicaid in areas where costs are higher. We discuss the implications of this result in the concluding section.

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* The estimated coefficients of this quadratic describe a U function with a minimum approximately at the mean i.e. the probability of participation increases for values of this variable above the mean.

Changes Over Time. Finally, the year binaries suggest that relative to 1974, participation is higher in each year with 1976 being the peak year of participation, other things equal. (The 1976 year binary is for the first quarter of the year which precedes the fee schedule increase of late 1976). The year binaries are in effect "dummy" variables and capture any effect which is associated solely with a particular year. If, for example, there were changes in the general health of the population such as a flu epidemic or there was an administrative change of policy by Medicaid regarding prior approval of medical services, the effect of such changes would be captured by the year binary.**

3. The Supply of Medicaid Services

We now focus on the supply or amount of Medicaid services provided by participating physicians, i.e. we restrict the analysis to physicians who saw ten or more different Medicaid patients per quarter. The empirical results are provided in Tables IV-7 and IV-8 for primary care and surgery, respectively.

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* Our general impression is that the wage data, which are derived from Department of Commerce estimates of wages in physician offices by county, may not be reliable.

** See Section IV-D-4 for further discussion of this point.

Table IV-7

Regression Estimates of Medicaid Supply Responses for Participating Primary Care Solo Practice Physicians, California, 1974-1978[a]

Independent Variables	Coefficient Estimate (t Statistics) Dependent Variable Total RVUs/QTR (3)	RVUs/Patient (4)	Patient/Phys. (5)
A. Prices ($)			
1. Own Billed Amt/RVU	-3831.4 (-2.95)	-13.78 (-2.29)	-79.45 (-3.37)
2. Medicaid Allowed Amt/RVU	4814 (1.53)	2.48 (0.17)	99.76 (1.74)
B. Physician Characteristics			
1. Experience (Years)	-229.3 (-4.54)	-0.79 (-3.39)	-2.63 (-2.86)
2. Experience Squared	1.77 (0.89)	0.48E-2 (1.18)	.022E-1 (1.34)
3. Specialty Binaries			
a. Internal Medicine	-1528 (-5.78)	23.66 (19.33)	-56.61 (-11.79)
b. Pediatrics	2572 (5.53)	-3.93 (-1.82)	73.91 (8.75)
c. Obstetrics/Gynecology	6588 (17.54)	66.78 (38.41)	-1.13 (-0.17)
d. Orthopedic Surgery	— —	— —	— —
C. County Characteristics			
1. Medicaid Eligibles			
a. Non -aged elig./phy.	40.86 (6.80)	0.13E-1 (0.45)	0.92 (8.38)
b. Disabled	2,297.4 (0.42)	-40.58 (-1.59)	84.44 (0.85)
c. AFDC	14,952 (4.93)	59.60 (4.24)	201.60 (3.66)
d. Needy	25,894 (3.92)	219.00 (7.16)	209.10 (1.74)
2. Private Patients			
a. Phy./Non-Caid Pop.	2.33xE6 (3.78)	3165 (1.11)	38493 (3.44)
b. (Phy./Non-Caid Pop.) squared	-3.31xE7 (-3.35)	15.95E4 (0.35)	-4.99xE6 (-2.78)
3. Cost of Inputs			
a. House Cost	-18.28 (-2.00)	0.95E-1 (2.24)	-0.45 (-2.73)
b. Wages in Phys. Office	1.32 (0.44E-2)	-0.59E-1 (-0.43)	0.47 (0.87)
c. Population/square mile	500.0 (3.36)	-0.58 (-0.83)	6.80 (2.48)
D. Year Binaries 1975	1157 (3.01)	8.22 (4.62)	8.67 (1.24)
1976	2170 (4.91)	12.73 (6.23)	21.61 (2.70)
1977	2005 (3.76)	-2.07 (-0.84)	41.38 (4.27)
1978	1754 (3.00)	-9.87 (-3.66)	51.75 (4.89)
E. Constant	-117.8. (-1.94)	-9616.5 (-2.87)	4.21 (0.27)
* * * * * * * * * * * * * * *			
Mean of Dependent Variable	4942.7	59.1	93.9
R^2/n	0.12/5065	0.30/5065	0.10/5065

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[a] Sample is restricted to physicians with ten or more patients.

Table IV-8

Regression Estimates of Medicaid Supply Responses
for Participating Surgeons, Solo Practice,
California, 1974-1978[a]

	Coefficient Estimate (t Statistics) Dependent Variable		
Independent Variables	Total RVUs/QTR	RVUs/Patient	Patient/Phys.
	(6)	(7)	(8)
A. Prices ($)			
1. Own Billed Amt/RVU	-1478 (-1.75)	23.4 (2.13)	-23.5 (-1.73)
2. Medicaid Allowed Amt/RVU	5102 (2.05)	-76.5 (-2.36)	99.85 (2.50)
B. Physician Characteristics			
1. Experience (Years)	-62.58 (-1.09)	0.96 (1.28)	-1.31 (-1.42)
2. Experience Squared	(0.91E-3) (0.80E-3)	-0.29E-1 (-2.12)	0.13E-1 (0.75)
3. Specialty Binaries			
a. Internal Medicine	---	---	---
b. Pediatrics	---	---	---
c. Obstetrics/Gynecology	---	---	---
d. Orthopedic Surgery	-947.8 (-4.55)	-18.85 (-6.94)	-9.82
C. County Characteristics			
1. Medicaid Eligibles			
a. Non-aged elig./phy.	23.81 (4.63)	0.47E-1 (0.70)	0.39 (4.66)
b. Disabled	-4215 (-0.92)	-86.4 (-1.44)	12.7 (0.17)
c. AFDC	6015 (2.87)	42.3 (1.55)	54.8 (1.63)
d. Needy	8102 (1.59)	218.3 (3.28)	22.0 (0.27)
2. Private Patients			
a. Phy/Non-Caid Pop.	7.98E5 (1.52)	-6730 (-0.98)	27345 (3.24)
b. (MD/Pop) squared	-1.70E8 (-2.12)	1.87E6 (1.79)	-5.62E6 (-4.37)
3. Cost of Inputs			
a. House Cost	7.98 (0.91)	-0.17 (-1.48)	0.28 (1.97)
b. Wages in Phys. Office	2.75 (0.11)	0.15 (0.45)	0.81E-2 (0.19E-1)
c. Population/Mi	340.0 (2.82)	-3.10 (-1.99)	8.80 (4.62)
D. Year Binaries 1975	402.1 (1.30)	6.01 (1.49)	-1.08 (-0.22)
1976	1094 (3.02)	8.71 (1.85)	4.93 (0.85)
1977	834.2 (1.96)	5.77 (1.04)	3.26 (0.48)
1978	436.1 (0.92)	-2.91 (-0.47)	2.97 (0.39)
E. Constant	-3743 (-1.40)	76.1 (2.19)	-73.2 (-1.71)
Mean of Dependent Variable	3278.6	80.82	45.64
R^2/n	0.07/1874	0.06/1874	0.05/1874

[a] Sample is restricted to patients with ten or more patients.

Price Variables. The price variables (own billed amount and Medicaid allowed amount) generally have the expected sign. For surgeons and primary care physicians, the coefficients on own billed price and Medicaid price in both the total supply (Eqs. 3 and 6) and the total number of Medicaid patients per physician (Eqs. 5 and 8) equations were negative and positive respectively. This is consistent with the theory presented above in Section II. The price coefficients in the RVUs per patient equations are less consistent and vary by price parameter and by specialty. As discussed above in Section II our theoretical predictions for this measure are less clear and the results are consequently more tentative.

Physician Characteristics. The quadratic measures of physician experience (years since graduation) generally describe declining participation and supply of services to Medicaid with greater physician experience for both specialty groupings. Generally, the location of the minimum described by the quadratic terms is so large (60 to 80 years) that for practical purposes physician Medicaid output decreases continuously over a physician's lifetime, other things equal.

As measured by total Medicaid output per quarter, pediatricians, obstetricians and gynecologists supply more than GPs while internists supply less than GPs. In terms of the number of different patients per physician, obstetricians and gynecologists treat about as many Medicaid patients as do GPs while pediatricians treat substantially more than GPs; internists treat fewer Medicaid patients than do GPs.

On per patient basis, pediatricians provide slightly fewer RVUs than do the GPs while the internists, obstetricians, and gynecologists provide substantially more than the GPs with the OB/GYN levels being dramatically higher than those of the average GP.

An overall comparison to the average GP shows that obstetricians and gynecologists supply much more output to Medicaid, primarily due to more RVUs per patient. Similarly, the pediatricians also provide more RVUs per quarter than do the GPs, primarily by treating larger numbers of patients. Internists have lower total Medicaid output per quarter, compared to GPs, primarily because they treat fewer Medicaid patients. The Medicaid patients seen by the average internist however, do receive a greater quantity of services than the patients seen by GPs.

Orthopedic surgeons supply dramatically fewer total services than do the general surgeons. This results from treating both fewer patients than the general surgeon and from providing fewer services per patient.

When comparing RVUs per patient, the quadratic functions for the two specialty groups are distinctly different. The primary care quadratic of experience describes a rather flat upside-down saucer with a maximum at 16 years experience. The surgery experience measures describe a declining function of RVUs per patient over relevant ranges of experience. For both specialties, however, the differences in RVUs per patient, ascribable to differing years of experience, are not quantitatively large. For example, a change of one standard deviate in physician experience (10 years) changes the RVUs per patient by 4 percent at the mean for primary care and 6 percent at the mean for surgery.

Characteristics of Medicaid Eligibles. The characteristics of the Medicaid eligible population in the physician's county describe how changes in the eligible population affect a physician's supply of services to the Medicaid program, other things being equal. First, the coefficients on the non-aged eligibles per physician generally show that increases in the number of eligibles increase the supply of services to Medicaid, primarily through the treatment of more patients. There appears to be little or no effect on the number of RVUs per patient.

Holding constant the number of non-aged eligibles per physician, differences across counties in the composition of the Medicaid population also affect a physician's supply of services to Medicaid. The percent of a county's eligibles who are categorized as needy has dramatic impact on physician supply (relative to the excluded group of the aged and indigent Medicaid eligible). Higher proportions of the medically needy imply substantially higher patient loads per physician and higher RVUs per patient. For example, the RVU per patient for the medically needy is almost four times the average for the primary care physicians and more than twice the average for the surgeons. These observations reflect, of course, the generally accepted notion that the medically needy have substantially poorer health than the average Medicaid eligible since their payments for medical care are a primary determinant of eligibility. The proportion of the eligibles who are entitled under the AFDC program generally has a similar, but smaller, effect on physician supply of Medicaid services. In other words, compared to the excluded group (aged and indigent), AFDC eligibles lead to higher patient loads per physician and higher RVUs per patient, although the effects are approximately half that observed for the medically needy.

Finally, the proportion of the county eligibles that are disabled appears to have little effect on physician supply. Curiously, the disabled appear to receive fewer RVUs per patient from both the primary care physicians and surgeons than the aged and medically indigent. One might expect the disabled to receive proportionately more services.

Costs of Inputs. The three measures of cost in the physician's county are average new house price, average salary of employees in physician's offices (county wide) and population per square mile, a proxy for measures of cost. The coefficients for these three measures of cost present a mixed pattern for which interpretation is somewhat difficult. If there is a general pattern, it suggests that higher costs lead to both higher total output and higher patient loads per physician with no effect on RVUs per patient. If correct, these effects may offset those reported above for the participation equation. That is, higher costs lead to lower Medicaid participation rates for physicians in general, but the output for those physician who do participate is higher. Whether the higher output levels of participants in high cost areas is great enough to offset the lower participation rates is uncertain but at least the differences in output levels for participants appears to partially offset the lower levels of participation.

Changes Over Time. The year binaries measure secular changes over time which are not accounted for by any other variable. The patterns are clearly different for the two specialty groupings of physicians. First, we discuss the primary care physicians. Compared to the excluded year of 1974, there is a substantial increase in total Medicaid output for each year, other things equal. For example, total Medicaid output in 1975 was approximately 23 percent higher than the mean (1157/4943). For each succeeding year, the difference was approximately twice as great as that between 1974 and 1975. For example, in 1977, the average physician provided 2005 more RVUs than in 1974. We should stress that these are differences over time that are "unaccounted for" by other variables in the model such as the increase in the fee schedules.* These differences may stem from a number of causes, such as changes in health status over time or perhaps a relaxation of the administrative burden associated with participation in the Medicaid program. These explanations are, of course, speculative, but the fact remains that there appears to be a secular increase with time in primary care physicians' willingness to supply services to the Medicaid program over and above that accounted for by the variables in the model. This increase in total output by primary care physicians, appears to derive mainly from higher patient loads per physician with only minor changes in the number of RVUs per patient.

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* The discrete nature of the fee schedule increase in late 1976 implies some correlation between the 1977 year binary and the Medicaid price. The effect of this would be to "load" some of the fee schedule change on the 1977 binary. We discuss this issue below.

The pattern for the surgeons over time is distinctly different than that observed for the primary care physicians. While there are "unaccounted for" increases in the total supply of Medicaid services per physician, the changes are substantially smaller in both absolute and percentage terms. There were almost no secular changes in the number of patients per physician and some increase in the number of RVUs per patient, other things equal. This observed difference over time between primary care physicians and surgeons is one of the most distinct differences between these specialties on which we can report. One cannot be certain of the source of this difference, but it should be noted that it may be related to the "twisting" of the fee schedule towards primary care. First, the patterns of supply (patients per physician, RVUs per patient and total RVUs per physician) for surgeons and primary care physicians are distinctly dissimilar. Second, for the primary care physicians, the increases in total output over time which were observed prior to the fee schedule change (see the 1975 and 1976 binaries) were different than those observed after the change. As shown in Table IV-9, the average annual "unaccounted for" change in total RVUs prior to the fee schedule change was 34 percent of the mean and 38 percent after the fee schedule change. However in the period prior to the fee schedule change, this growth in total output was

Table IV-9

"Unaccounted For" Changes Over Time in the Supply of Medicaid Services by Primary Care, Solo Practice Physicians, California, 1974-1978[a]

Period	Average Annual Change (Percent of Mean)[b] Total Output Per Physician	RVUs Per Patient	Patients Per Physician
Prior to Fee Schedule Change (1975-1976)	34	18	15
After Fee Schedule Change (1977-1978)	38	-10	50

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[a] Sample is restricted to participants with 10 or more different patients per quarter.

[b] Medicaid output only.

almost evenly distributed between growth in the number of patients and growth in the RVUs per patient. After the fee schedule change, however, the pattern is distinctly different. The number of patients per physician increased dramatically (50 percent of the mean) with a decrease in the number of RVUs per patient for primary care physicians.

Qualitatively, these changes over time suggest that the estimated price effects may underestimate the true effect of the fee schedule change, at least for the primary care physicians. In other words, the high Medicaid price elasticities we reported above may understate the magnitude of the effects of the Medicaid fee schedule change, because some of the response may be measured by the year binaries. The pattern of supply side changes reported in Table IV-9 is certainly consistent with this hypothesis. Undoubtedly some of the change in the fee schedule will be measured by the 1977 year binary.

One might have specified a model without the year binaries. We elected the specification with year binaries because it seems likely that there were other unobserved changes correlated with time that would best be captured by these variables. However, this procedure probably leads to some underestimate of the effect of price on physician supply decisions. We discuss this issue in more detail in the next section.

4. Quantitative Implications for Policy

Medicaid Prices. A fundamental question is what effect does changing the Medicaid price level have on physician behavior? How much does Medicaid price affect participation? the supply of services? The results, presented above have shown the direction of the effects, but now we would like to be more specific.

The results show that when Medicaid prices are increased, physicians are more willing to participate and supply services to the Medicaid program, other things being equal. But will other things be equal? Specifically, what other effects might there be from an increase in the Medicaid fee level? A matter of some concern is what happens to private prices? The model developed in Section II demonstrated that as Medicaid prices rise, physicians will reduce their supply of services to the private market and raise private prices. But is that the end of the story? The answer depends on the response to the increased prices in the private market, particularly over the longer run. It seems reasonable that the private market will react, at least partially, to the increased private prices. Non-Medicaid persons or their agents (unions, employers, etc.) may adjust their medical insurance coverage to compensate, at least partially, for the higher private prices. In Feldstein's terms people buy more insurance because of the high cost of health care.* This is equivalent to a shift outward in the private demand function developed in the model of Section II above. Whether the adjustment in the private demand function will be sufficient to totally offset the higher private prices is not certain but it is plausible that some adjustments may occur. Consequently, physicians in the long run will be encountering financial forces which partially offset the fiscal attractiveness of treating more Medicaid patients, but we are not sure how much the private market will adjust. For example, higher private prices, will attract more physicians to the state. Therefore even if the private demand function does shift as a reaction to the private price increase, an increased supply of physicians will itself offset the price pressures of increased private demand. The dynamic effect over time of increased Medicaid prices on private prices is a complex story.

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*See Pauly, Mark V., National Health Insurance, American Enterprise Institute, Washington, D.C. 1980, pg 209.

We can divide the total effect of changes in Medicaid price on physician supply of services into two parts:

1. The direct effect of a change in Medicaid price on the willingness of physicians to participate in the program and their willingness to supply services to Medicaid. The empirical results presented above have focused primarily on these phenomena.

2. The indirect effect of a change in Medicaid price on physicians' private price and the effect this may have on the private demand for medical care. If private demand shifts to compensate totally or in part for the increased private price, physicians will be less willing in the long run to treat Medicaid patients than they were initially. The particulars of this effect were only discussed briefly above.

We can quantitatively state the total effect of a change in Medicaid price on physician supply as follows:

$$(4) \qquad \frac{dQ_{supply}}{dP_{mcaid}} = \frac{\partial Q_{supply}}{\partial P_{mcaid}} + \frac{\partial Q_{supply}}{\partial P_{private}} \cdot \frac{\partial P_{private}}{\partial P_{mcaid}}$$

where: Q_{supply} is the supply of services to the Medicaid program and supply refers to the four separate measures of physicians response described above,

P_{mcaid} is the Medicaid price, and

$P_{private}$ is the private price.

The two terms on the right hand side of (4) represents the direct and indirect effects respectively. The direct effects are the coefficient estimates presented above in Section IV-B. The first term in parentheses is the effect of private price on the supply of Medicaid services and was also estimated above. The second term in parentheses is the effect of Medicaid price on private price. Estimates of this parameter were developed as part of the first stage estimation in the two stage process and are presented in Appendix C. We cannot say, however, whether the private market reacts by adjusting their demand for care sufficiently to totally offset this change.

In summary, we can divide the effect of a change in Medicaid price on physician supply into two parts; a direct and an indirect effect. The direct effect is reasonably straightforward and can be easily estimated. The previous section presented these results. The direction of the direct effect is such that higher prices lead to more physician supply of services to Medicaid. The indirect effect, which is not as clearly understood, is the impact of Medicaid price changes on physician private prices which can lead, in the longer run, to physicians adjusting their supply decisions in an opposite direction, i.e., physicians may be less willing to treat Medicaid patients in the longer run than they are initially after a Medicaid price increase. We are not certain of the precise magnitude of the indirect effect, because it depends on how the private demand for medical care may react to a change in private prices brought about by the increased Medicaid price. We can, however, put a likely upper-bound or limit on the size of the indirect effect. We do this by using the structural equations estimated above, and adding the effect of Medicaid price on private price.

For purpose of illustration, we present a numerical example. The empirical results presented above (Table IV-7, equation (5) showed that the partial derivative (for primary care physicians) of the number of Medicaid patients with respect to the Medicaid price was 99.76, and the partial derivative with respect to private price was -79.45. The first stage equation, (Appendix C) shows a partial derivative of the billed amount with respect to the Medicaid price of 0.835. These quantities lead to an estimate of the total effect as follows:

$$\frac{dQ_{supply}}{dP_{mcaid}} = 99.75 + (0.835)(-79.45) = 33.40$$

In other words, the indirect effect of -66.34 (the product of the terms in parenthsis) is opposite in sign to the direct effect (99.75) and at its likely maximum, it reduces the direct effect from 99.75 to 33.40 or 67 percent. For the sake of simplicity we will refer to total estimates derived in this manner as structural estimates.

An alternate method for estimating the total effect of a change in the Medicaid price on physician supply is to estimate a reduced form of the supply functions for participating physicians. The procedure is to regress the supply measures for participants (total RVUs, RVUs per patient, patients per physician) on the exogenous variables included in the first and second stage equations. This technique produced results which are very similar to the structural estimates (actually the maximum effects). These reduced form estimates of the total effect are presented in Table IV-10 as elasticities along with the elasticities for the direct effect and the structural estimates.

The data of Table IV-10 show that the direct effects are always larger than the total effects and usually by a substantial amount. While the reduced form estimates are similar in size to the structural estimates of the total

Table IV-10

Three Estimates of Medicaid Price Elasticity of Supply, By Specialty [a]

Supply Parameter/Specialy	Direct Effect Only[b]	Total Effect Structural[c]	 Reduced Form
A. Primary Care			
1. Total RVUs Per Quarter	0.560	0.187	0.231
Index Number	100	33	41
2. RVUs Per Patient	0.024	-0.088	-0.067
Index Number	100 -	n.a.	n.a.
3. Patients Per Physician	0.611	0.205	0.282
Index Number	100	34	46
B. Surgery			
1. Total RVUs Per Quater	0.915	0.642	0.506
Index Number	100	70	55
2. RVUs Per Patient	-0.557	-0.381	-0.435
Index Number	100	68	78
3. Patients Per Physician	1.286	0.975	0.924
Index Number	100	76	72

[a] All estimates are at the mean of the sample. Only physicians with 10 or more patients are included.

[b] This estimate is based on the partial derivative contained in Tables IV-7 and IV-8.

[c] This estimate combines first and second stage estimates. The partial derivatives of private price with respect to the Medicaid price are 0.84 and 1.03 for primary care and surgery, respectively.

effect, the reduced form estimates are generally closer than the structural estimates to the direct effect only. This suggests that the private market demand does indeed adjust to the effect of a Medicaid price change on private prices but perhaps not by as much as suggested by the structural estimates. Overall, it would appear that the indirect effect of a Medicaid price change may counteract up to 60 percent of the direct effect for primary care physicians and up to 45 percent of the direct effect for the surgeons.

Similar estimates of the direct and indirect effect on participation were made. For primary care physicians, the direct effect of Medicaid price on participation has an elasticity of 0.60. Using the structural equation estimate of the indirect effect, the total effect would be reduced to an elasticity of 0.02. For surgeons, the elasticities are substantially higher, with a direct effect elasticity of 1.79 and a total effect of 1.14. Obviously, the structural estimate of the total effect of Medicaid price suggests that the indirect effect is quite large particularly for primary care physicians.

Effects Time Specification on Price Estimates. Previously, we mentioned the problem of including the year binaries in the estimation of supply response above, and the of probable underestimation of the Medicaid price effects on physician supply. However, to exclude the year binaries probably overestimates the price effect. What is the range of these estimates? Table IV-11 shows the Medicaid price elasticities for the four physicians supply measures of this study estimated with and without the year binaries. The estimates are for the "total" effect estimated using the structural equations.

The results presented in Table IV-11 prompt the following observations:

- The time binary does change the magnitude of the estimated Medicaid price effect in the direction

Table IV-11

Medicaid "Total" Price Elasticities With and Without A Time (Year) Binary, California, Solo Practice Physicians, 1974-1978[a]

Supply Parameter	Primary Care			Surgery		
	Year Binary			Year Binary		
	With	Without	Mean	With	Without	Mean
A. Probability of Participation in the Medicaid Program	0.02	0.09	0.06	1.14	1.13	1.13
B. Medicaid Quantity Supplied: (Given Participation):						
1. Total RVUs Per Quarter	0.19	0.43	0.31	0.64	0.76	0.70
2. RUVs Per Patient	-0.09	-0.50	-0.30	-0.38	-0.50	-0.44
3. Patients Per Physician	0.21	0.88	0.55	0.98	1.14	1.08

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[a] Price elasticities are the net effect; i.e., they include both the direct effect (the effect of Medicaid price on supply) and the indirect effect (the effect of Medicaid price on private price).

hypothesized (i.e. the price estimates are quantitatively larger when the year binaries are excluded.

- The effect of the time binary specification is more severe for the primary care physicians than for the surgeons.
- The effect of the time variable on participation estimates for primary care physicians, while relatively large, applies to such a small base that the difference does not matter much for practical purposes. The estimates of total price elasticity of participation with and without the year binary are 0.02 and 0.09, respectively. There is almost no difference between the two estimates for surgeons.
- The differences in the estimates for the other supply quantities for the primary care physicians are also substantial, but again for a fairly small base. For example, a change in elasticity for total RVUs from 0.19 to 0.43 while large in comparison to the base, may not be that large for the purposes of policy.

What do the results of Table IV-11 suggest for policy? (for the remainder of this discussion we will use the mean of the estimates with and without the year binary). The data of Table IV-11 suggest the following:

- The total Medicaid price effect of participation for primary care physicians appears to be very low. Consequently, it would appear that changes in the Medicaid price level do not appear to have substantial impact on the decision to participate in Medicaid i.e. the proportion of the physician pool participating does not increase substantially as a consequence of higher Medicaid fees.
- Higher Medicaid fees do, however, expand the pool of surgeons who participate since the elasticity estimates are fairly large. (1.13)
- Higher Medicaid fees lead to participating physicians seeing substantially more Medicaid patients. While there is an increase in the total supply of RVUs per physician for an increase in Medicaid fees, the increase is substantially less than the increase in the number of patients seen by each physician. The difference is accounted for by fewer RVUs per patient. There are at least two potential explanations for such phenomena. First, as the number of patients seen by a physician increases, access to care increases implying that patients see more different physicians and the average RVU per

> patient decreases. Under this explanation patients obtain more total services, even if the number obtained from each physician decreases.
>
> The second potential explanation is that the easier patient access, brought on by participating physicians being more willing to see Medicaid patients, is accomanied by patient mix changes. In other words, more healthy patients are brought into the system under the higher Medicaid price, and they require fewer RVUs per patient.
>
> We are unable to distinguish between these explanations because our data is physicians-specific and we cannot trace the movement of patients among physicians.*

Quantitative estimates of the effect of the 1976 Medicaid fee increase on physician supply are shown in Table IV-12. Separate estimates are provided by specialty and by direct and total effect. (The total effect estimates are based on the structural model estimates of the indirect effect of Medicaid price changes on private prices). The estimates are given for an increase of 20 percent for primary care and of 10 percent for surgery. (See the following discussion for more details). As in the discussions above we observe that the direct effects of the 1976 fee increase were fairly large. The probabilities of participation increased 11 and 17 percent and total RVUs per physician participant increased 9 and 12 percent. Total patients per physician also increased by a substantial 14 to 17 percent.

The effect in the long run is likely to be smaller. The long run (total) results (with the exception of participation for primary care) are, however, still likely to be substantial. Total Medicaid RVUs per physician increased 6 to 7 percent while patients per physician increased 11 percent. The probably of participation, which applies to our sample of physicians as well as the

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* The Urban Institute is conducting a study which will answer these questions by tracing the patterns of medical care use for a sample of Medicaid beneficiaries.

Table IV-12

The Effect of the 1976 Medicaid Fee Increases Per Physician on the Supply of Medicaid Services California Solo Practice [a]

Supply Measure	Implied Change In Supply (Per Physician)			
	Direct Effect		Total Effect	
	Primary Care	Surgery	Primary Care	Surgery
1. Probability of Participation	10.8%	16.6%	1.2%	11.3%
2. Total RVUs Per Physician	12.0	9.2	6.2	7.0
3. RVUs per Patient	-1.8	-6.1	-6.0	-4.4
4. Patient Per Physician	17.0	13.5	11.0	10.8

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[a] Assuming a Medicaid price change of 20 percent for primary care and 10 percent for surgery. Elasticities are the mean of the estimates from regression specifications with and without year binaries. Total effect elasticities were estimated from the structural equation and reflect the effect of Medicaid price increases on private price.

pool of existing and new-physicians increased substantially for surgeons (11.3 percent) but only minimally for primary care physicians. We have focused on the total effect which incorporates our estimate of the indirect effect of Medicaid prices on private prices. We have some reservation about the magnitude of the indirect effect and therefore note that the direct effect of the Medicaid fee increase is 30 to 60 percent greater than the total effect.

The Effects of Private Prices. Changes in Medicaid prices were not the only price changes occurring during this period. Private prices were increasing at a substantial rate, although two thirds of the increase occurred in the early part of the period (1974-1976) perhaps as a "catch up" after the the removal of price controls in 1974. For ease of discussion we have averaged the private price changes over the period as shown in Table IV-13. Private prices (per RVU) increased at an average annual rate of approximately 10 percent over the period 1974-1978 with a total price change of 46 to 50 percent. The Medicaid price change of 1976 is also shown in Table IV-13 as 14 to 20 percent depending on the specialty.

First stage estimates of the elasticity of private price with respect to Medicaid prices are approximately 0.6.* Using this value, we can estimate the effect of the 1976 Medicaid fee increase on private prices. As shown in Table IV-13, the Medicaid fee increase may have lead to a 9 to 12 percent increase in private prices with the precise amount varying by specialty. The data of Table IV-13 show that removing the effect of Medicaid prices yields estimated increases in private prices of 35 and 40 percent (for primary care and surgery respectively) for the period 1974-1978.

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* More precisely the estimates were 0.57 for primary care and 0.66 for surgery. See Appendix C.

Table IV-13

Rates of Change In Private and Medicaid Price, California, Solo Practice 1974-1978 a/

Price Change Per Year	GP-FP	IM	GS	All b/
Medicaid Price Change				
1976-1977 (%)	19.3	19.8	14.5	18.2
Medicaid's "Effect" on Price Price % (Elasticity = 0.6) c/	11.6	11.9	9.3	10.9
Private Prices				
Annual Rate of Change 1974-1878 (%)	10.0	10.0	10.6	10.2
Total Change 1974-1978 (%)	46.4	46.4	49.6	47.5
Total Change Less Medicaid "Effect" 1974-1978 (%)	34.8	34.5	40.3	36.6
Annual Change Less Medicaid Effect (%)	7.8	7.7	8.8	8.1

---

a/Data are county wide averages weighted by the number of physicians in the V.I. sample in that county. Prices are measuraed in $/RVU.

b/Mean of GP-FP, IM, GS.

c/Precise elasticity estimates from the first stage equation were 0.57 for primary care and 0.66 for surgery.

Estimates of the quantitative implications of these private price changes are given in Tables IV-15 and IV-16 below. At this point we wish to note that the impact of these changes is substantial and any overview of the impact of changes in Medicaid prices should consider the effect of private prices as well. Our focus on the 1974-1978 period is of course arbitrary since the Medicaid fee was increased once in 1976 after 10 years of nearly constant fees. We focus on this period to facilitate comparison the effects of changes in the two price variables.

Changes In the Physician Supply and the Number of Eligibles. As discussed above the substantial growth in the number of Medicaid eligibles and in the number of physicians had significant effects on the Medicaid program. The rates of change of these two variables are shown in Table IV-14. The number of Medicaid eligibles per physician grew at an annual compound rate of 3.6 percent. Over the entire four years this represents a 15 percent increase. The ratio of physicians to "private patients"* increased by 3.2 percent per year, a total of 13 percent for the period 1974-1978. These are certainly substantive changes in basic underlying market conditions which can affect the supply of services to the Medicaid program.

The eligibles per physician (EPP) elasticities of supply are fairly high and similar for both primary care and surgery. For the probability of participation, total RVUs and Medicaid patients per physician, the elasticities with respect to EPP range from 0.4 to 0.6 These elasticities reflect an indirect effect of EPP on private price and imply a change of nearly 2 percent per year in physician supply to Medicaid.

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* The denominator includes all persons other than non-aged Medicaid eligibles.

Table IV-14

The Effect of Changes In Medicaid Eligibility and The Supply of Physicians On Physician's Supply of Medicaid Services, California, 1974-1978 [a]

Specialty/ Supply Factor (x)	Change In x Per Year [b]	Implied Change In Supply Per Year			
		Participation	Total RVU Per Physician	RVUs Per Patient	Total Patient Per Physician
A. Primary Care					
1. Eligibles Per Physician [c]	3.6%	1.30%	1.69%	0.04%	1.98%
Elasticity		0.36	0.47	0.01	0.55
2. Physician Per Private Patient	3.2	0.51	3.46	0.54	0.25
Elasticity		0.16	1.08	0.17	0.39
B. Surgery					
1. Eligibles Per Physician [a]	3.6	1.48	1.44	0.14	1.69
Elasticity		0.41	0.40	0.04	0.47
2. Physician Per Private Patient	3.2	0.96	0.03	0.22	-0.03
Elasticity		0.30	0.01	0.07	-0.01

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[a] Elasticities were estimated with year binaries and are the total effect estimated through the structural equations.

[b] Mean of GP-FP, IM, GS.

[c] Non-aged eligibles.

Physicians Per Patient (PPP) show a much more varied set of elasticities than does EPP. For primary care, the estimated elasticity of total RVUs with respect to PPP is 1.08; for the probability of participation, 0.6, and for total patients per physician 0.39. With the exception of participation, the elasticities for surgeons are fairly small. Participation for surgery was reasonably elastic with respect to PPP with a point estimate of 0.30. These elasticity estimates, incidently, reflect an indirect effect through the private price equation as well as the direct effect on Medicaid supply. Higher PPP lead to lower private prices (see Appendix C) which then induce physicians to supply more Medicaid services.* The magnitude of the effects of PPP on Medicaid Supply are shown in Table IV-14.

Net Effects. We now bring together the net effect of the four influences on Medicaid supply which we have presented independently. We should again note two conditions of our analysis. First, there is an indirect effect of Medicaid price increase on private prices which is likely to lead in the long run to a diminishing of the direct effect. The net estimates to be presented reflect our best judgement of the magnitude of this effect but the issue of the indirect effect is still subject to debate in both the conceptual and empirical literature. Readers who prefer to ignore this issue can either refer to a previous section which presents the direct effects or they can inflate the net results by a factor between 1.4 and 2.5. Secondly, we note that we have used the private price change for the period 1974-1978 as a standard by which to compare the three other changes affecting Medicaid supply. This is an arbitrary choice and there is no theoretical reason to choose this period or this rate of private price change as a standard. But the use of this standard does add some dimension to the net effects.

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* The elasticity of private price with respect to physicians per private patient was -0.02 and -0.03 for primary care and surgery respectively.

The net effects of the four independent influences on the probability of participation in Medicaid are shown in Table IV-15. Clearly the most dominant influence is the change in private price. For both specialty groupings, the elasticity estimates are approximately -0.9 which combined with a 35 to 40 percent change in prices implies dramatic negative influences on the likelihood of participation in Medicaid.

As developed above, the Medicaid price elasticity of participation for primary care was very small, so there is not much offsetting effect from this source. For both specialties, the effects of the changes in the number of eligibles and the supply of physicians are certaintly non-trivial, but again small compared to the effect of the private price change. For primary care the effect of both the change in eligibility and that of physician supply exceeds the effect of the Medicaid price change. On balance, the net effects of these four variables is certaintly to put some downward pressure on the probability of participating in Medicaid.

The net effect of these four independent influences on total Medicaid RVUs and Medicaid patients per physician are shown in Table IV-16. The net effect for primary care is a positive 8.9 percent for total RVUs and 11 percent for patients per physician. For surgery, the net effect was slightly negative with net changes of -1.6 and -1.7 percent for total RVUs and patients respectively.

For primary care, the negative effects of the private price changes were offset by each of the three other influences which contributed substantially to both total RVU and patients per physician. In contrast, the change in physician supply did not have much influence on the Medicaid supply for surgery.

TABLE IV-15

The Quantitative Effect of Changes in
Selected Variables on Physician Participation in Medicaid
Solo Practice Physicians, California 1974-1978 [a]

Specialty	Independent Variable (x)	Change In x, 1974-1978 (%)	Participation In Medicaid Elasticity	Participation In Medicaid Implied Change 1974-1978, (%)
A. Primary Care				
Mean Probability of Participation				52%
	1. Private Price	35.0	-0.92	-32.2
	2. Medicaid Price	20.0	0.06	1.2
	3. Eligibles Per Physician	15.2	0.36	5.5
	4. Physicians Per Private Patient	13.4	0.16	2.1
	Net of A1 to A4			-23.5
B. Surgery				
Mean Probability of Participation				50%
	1. Private Price	40.0	-0.87	-34.8
	2. Medicaid Price	10.0	1.14	11.1
	3. Eligibles Per Physician	15.2	0.41	6.2
	4. Physicians Per Private Patient	13.4	0.30	4.0
	Net of B1 to B4			-13.5

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[a] Definition of participation is 10 or more different Medicaid patients per quarter. Private price change is net of Medicaid influences. Elasticity estimate for the price variables are the mean of results from the specification with and without the year binary and are the total effects estimated with the structural model.

TABLE IV-16

The Quantitative Effect of Changes in Selected Variables on Total RVUs and Patients Per Physician, Solo Practice, California, 1974-1978[a]

Specialty	Independent Variable (x)	Changes In x, 1974-78 (%)	Total RVU		Patients Per Physician	
			Elasticity	Implied Changes 1974-1978	Elasticity	Implied Changes 1974-1978
A. Primary Care						
	Mean of Dependent Variable			4942		93.9
	1. Private Price	35.0	-0.54	-934 (-18.9%)	-0.37	-12.2 (-13.0%)
	2. Medicaid Price	20.0	0.31	306 (6.2%)	0.55	10.3 (11%)
	3. Eligible Per Physician	15.2	0.47	751 (7.1%)	0.55	7.9 (8.4%)
	4. Physician Per Physician	13.4	1.08	715 (14.5%)	0.39	4.9 (5.2%)
	Net of A1 to A4			438 (8.9%)		10.9 (11.7%)
B. Surgery						
	Mean of Dependent Variable			3279		45.6
	1. Private Price	43.2	-0.37	-485 (-14.8%)	-0.47	-8.6 (-18.8%)
	2. Medicaid Price	10.0	0.70	230 (7.0%)	1.06	4.8 (10.6%)
	3. Elgible Per Physician	15.2	0.40	199 (6.1%)	0.47	3.3 (7.1%)
	4. Physician Per Private Patient	13.4	0.01	4 (0.1%)	-0.01	-0.6 (-0.1%)
	Net of B1 to B4			-52 (-1.6%)		-1.1 (1.7%)

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[a] The elasticity estimates for the price variables are the mean of the elasticity estimated with and without a year binary. The Medicaid elasticity is the total effect estimated using the structural model. The changes in private price are net of any Medicaid price effect.

C. Summary of Empirical Results

The empirical results presented above provide an interesting and useful picture of physician participation in the Medicaid program. The results are consistent with the theoretical model specified in Section II and suggest that the supply decisions made by physicians can be described by the conventional economic laws of supply and demand. The parameter estimates are also consistent with previous research, and indicate that the setting of Medicaid reimbursement rates may offer a powerful and efficient policy lever for affecting the direction and cost of the Medicaid program. Specifically we can cite the following results, which are summarized in Table IV-17.

Price Effects. Undoubtedly the most important results are that physicians, on average, respond to prices in a predictable and rational fashion. Two prices are relevant. The first is the private price and the second is the Medicaid price. As private prices increase, physicians are less willing to participate in Medicaid. However, as Medicaid prices increase physicians are more willing to participate in Medicaid. While the direction of these price effects is important, so too is the magnitude of the effects. Our results suggest that physicians' response to Medicaid prices are quite elastic with parameter estimates being consistently greater than 0.5 i.e. a ten percent increase in fees implies a five percent increase in participation.

Physician response to prices can be divided into two separate decisions. The first is whether or not to participate in the Medicaid program and the second decision is how many services to supply given that the decision to participate is positive. The empirical estimates suggest that the latter decisions are probably more important quantitatively. That is, the results clearly show that higher Medicaid fees bring more physicians into the program,

Table IV-17

Summary of the Empirical Results for Physician Participation and Physician Supply of Medicaid Services, California, 1974-1978

Parameter	Results (With Other Things Equal)
1. Physician's Private Price	Higher private prices lead to fewer physicians participating in the Medicaid program and a smaller supply of services to the program by participants.
2. Medicaid Price	Higher Medicaid fees lead to higher rates of participation and higher levels of supply to the Medicaid program. Quantitatively, the magnitute of the effects differ between specialties. For primary care the net effect of Medicaid prices on participation rates are likely to be small, but the effect on the supply of services for participants is fairly large. In contrast, for surgery, the net effect of higher Medicaid fees on both the probability of participation and the supply of services by participant is likely to be large.
3. Physician Experience	Older more experienced physicians are less likely to treat Medicaid patients. The effect of physician experience on RVUs per patient does not appear to be quantitatively large.
4. Physician Specialty	Compared to GPs, PEDs and OB/GYNs provide more total services per physician to the Medicaid program. PEDs see more patients than GPs while OB/GYNs mainly provide more services per patient than do GPs. Compared to GS, orthopedic surgeons see fewer Medicaid patients per physician, provide them with fewer services and supply fewer total services to Medicaid.
5. Medicaid Eligibles Per Physician	More Medicaid eligibles in the physi cian's county increases the physician's supply of services to Medicaid.

Table IV-17 (Cont'd)

Summary of the Empirical Results for
Physician Participation and Physician Supply of
Medicaid Services, California, 1974-1978

Parameter	Results (With Other Things Equal)
6. Physicians Per Private Patients	More physicians per private patient leads to more supply of services to the Medicaid program. Projected growth in the physician supply will lead to lower program cost for a given level of Medicaid services.
7. Cost of Inputs such as non-physician staff	Where input costs are higher, physicans have a lower tendency to participate in Medicaid. However, where costs are higher, participants in Medicaid are willing to supply more to the program, somewhat offsetting the effect of the lower participation rate.

but the effect of higher fees on supply, whether measured in total RVUs or in patients per physician, is much greater. In other words, higher Medicaid fees lead to a greater supply of services to the Medicaid program primarily through more output per physician rather than higher participation rates.

It should be noted that these results appear to be fairly robust and are not sensitive to the particular specification or techniques employed. Furthermore, these results are not observable by mere examination of the raw data, i.e. only when more proper statistical techniques are employed do these patterns emerge. While this remark may seem unnecessary to some readers, we should note that in the past, some observers have improperly concluded that there is no physician response to fees, relying primarily on the examination of gross data.

While the results regarding physician supply choices (the decision to participate in the program, the total supply effects and the number of patients seen by physicians) are fairly straightforward, the results on RVUs per patient are somewhat ambiguous. Higher Medicaid prices generally but not always lead to lower RVUs per patient seen. One possible explanation of this phenomenum is that higher Medicaid fees lead to increases in the availability of physicians (both new and existing participants) willing to treat Medicaid patients. Consequently patients have more choice and see a greater number of physicians with fewer RVUs per visit. Since we observe that the total number of services provided to the Medicaid program increases with higher Medicaid fees, the increase in the number of physician encounters must be greater than the decrease in the services per encounter.

Whether the social value of the increased availability and medical care use associated with higher Medicaid fees is worth the increased program costs can not be answered by this analysis. Answers to such questions depend on the system wide effects of physician fee schedule changes such as the effects on the hospital use as well as the valuation placed by patients and society as a whole on access to medical care. This analysis shows the response of physicians in terms of their willingness to treat patients. While this is a useful and insightful approach to the workings of the Medicaid program, it is nonetheless a limited aproach to a very complex question.

Physician Characterisitics. The experience variable presents a general pattern of declining participation and a declining supply of services as physician experience increases. This appears to be true for all relevant ages, i.e., as a physician's age increases, fewer and fewer services are supplied to the Medicaid program.

Specialty differences show that both pediatricians and obstetricians/gynecologists supply more total output per quarter to Medicaid than do GPs. For pediatricians, the greater quantity is achieved by seeing greater numbers of patients, while for OB/GYN, the higher output is achieved primarily through higher RVUs per patient. Orthopedic surgeons provides lower total output, see fewer patients and provide fewer services per patient than do general surgeons.

Characteristics of Medicaid Eligibles. In areas where there are more Medicaid eligibles, physicians supply more total Medicaid services and see more patients, other things equal. There does not appear to be an effect of the number of eligibles on the services per patient. These results suggest that the market for Medicaid patients does not demonstrate excess demand, i.e. the image of a queue of Medicaid patients waiting for a physician's beck and call is inaccurate. In other words, by some means the supply of Medicaid services appears to equal the demand for such services. Of course, this equilibrium may be be the result of imposing high inconvenience cost on patients so that the amount they demand is made equal to the supply. This analysis does not provide a total picture of the dynamics, but the absence of excess demand in Medicaid markets seems to contradict generally counter to the conventional wisdom regarding the Medicaid program.

Cost of Inputs. The impact of higher input costs on Medicaid supply decisions is somewhat ambiguous, although the general pattern tends to be negative i.e. higher input prices mean lower supply of services to Medicaid other things equal. This suggests that state wide fee schedules will tend to lower physician willingness to supply services in higher cost areas, (e.g., cities) other things equal. However, to the extent that high cost areas such as cities have higher physician to non-eligible population ratios, there will be an offsetting effect in that physicians will be more willing to supply services to Medicaid.

Physician Supply. When there are relatively more physicians per private patient, physicians are more willing to treat Medicaid patients. Since the physician supply in California during the period of this analysis was growing more rapidly than the private pay (non-Medicaid eligible) population, the effect of this change is to increase physicians' willingness to supply services to Medicaid. There are, in other words, supply side effects which derive from the growing supply of physicians. Because physicians increase their willingness to treat Medicaid patients, the program cost of providing a given level of services decreases as the supply grows. The projected large growth of physicians in the coming years will provide cost saving opportunities to the Medicaid program because the cost of a given level of Medicaid services will be lower than if the physician supply were fixed.

Appendix A: A Comparison of Major and Minor Medicaid Participants

This section extends the analysis of participation decisions by grouping individual physicians on the basis of their pattern of participation/non-participation across all five years of the study. The differences in the levels of the dependent and independent variables used in the analysis above are examined and the results of disaggregating the subsamples are compared. The differences in participation patterns between individual counties are also reported.

The sample physicians are divided into five categories using the "at least ten patients" definition of participation:

1. Never - no participation during the study period.
2. Drop outs - participation prior to the September 1976 fee increase but not after.
3. New Entries - participation only after the fee increase.
4. Interrupted - participation before and after the fee increase for a total of less than 5 years.
5. Continuous - participation in all five years.

Table A-1 presents the distribution of physicians across these five categories. In both primary care and surgical specialties the proportions never participating and the proportions continuously participating are roughly one third. Almost eight percent of the primary care physicians and 10.4 percent of the surgeons dropped out during the fee freeze. Some, but not all of these doctors were replaced by those entering after the fee increase - 3.8 percent in primary care specialties and 4.1 in surgery. Changes in participation by the physician in the "interrupted" group served to keep the gross participation rates nearly constant across all five years in both specialty classifications. It is evident from these numbers that the changes

TABLE A-1
Distribution of Sample Physicians by Participation Pattern[a]

Specialty/ Category	Participation in Medicaid	Number	Percent
A. Primary Care Physicians			
Never:	Never	816	37.0
Dropouts:	Before 1977 only	175	7.9
Interrupted:	Both before 1977 and after 1976:	383	17.3
	2 of 5 years	32	1.4
	3 of 5 years	85	3.8
	4 of 5 years	266	12.1
New Entries:	After 1976 only	84	3.8
Continuous:	Every year	750	34.0
Total:		2208	100.0
B. Surgeons			
Never:	Never	290	35.4
Dropouts:	Before 1977 only	85	10.4
Interrupted:	Both before 1977 and after 1976:	164	20.0
	2 of 5 years	19	2.3
	3 of 5 years	45	5.5
	4 of 5 years	100	12.2
New Entries:	After 1976 only	34	4.1
Continuous:	Every year	247	30.1
Total:		820	100.0

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[a] A physician is deemed a participant if he/she saw at least 10 different Medicaid patients per quarter.

in the fee schedule did not offset the opposing effects of rising prices for all doctors. The fee increase presumably encouraged some doctors in the interrupted group to resume Medicaid participation, and provided an incentive for those in the continuous group to maintain their participation status. It did not, however, result in an expansion of the pool of doctors participating.

An examination of the supply functions for major and minor participants indicates that the two groups behave in a similar manner but are faced with different external conditions. To test for differences in supply responses, the regression equations presented in Section IV were estimated for two subsamples: continous participants only, and all other participants. The F-statistics presented in Table A-2 indicate that the two groups do not come from the same population and that the regression coefficients (considered jointly) are not equal.

Tests of the equality of individual coefficients in the primary care equations showed no significant differences between the groups in their responses to the variables of policy interest--the Medicaid allowed amount per RVU, the billed amount per RVU, non-aged eligibles per physician and physicians per non-eligible. Significant differences were observed in the responses of primary care doctors to changes in employees salaries and in the effect of experience on supply. Continuous participants significantly increase the number of RVUs they supply in response to an increase in employee wages, other participants show no response. Both groups supply fewer RVU's as their experience increases, but the decline is less severe for continuous participants.

In the surgical specialties the statistically significant differences are in the change in the number of patients with respect to the Medicaid fee and the ratio of physicians to non-eligibles. An increase in the Medicaid fee

TABLE A-2

F - Statistics for Test of H_o: Continuous and Other Participants are Members of the Same Population[a]

Dependent Variable	Primary Care	Surgery
RVU's per Physicians	12.27*	10.15*
RVU's per Patient	1.68+	1.93*
Patient per Physician	10.73*	10.01*
n_1	21	19
n_2	5022	1836

---

* significant at 0.01 confidence level
+ significant at 0.05 confidence level

[a] A physician is deemed a participant if he/she saw at least 10 Medicaid patients per quarter.

increases the number of patients per physician for continuous participants but results in a decrease for other participants. The number of patients per physician rises and then falls for an increase in the doctors-non-eligible ratio for continuous participants reaching a maximum at 4.2 doctors per 1,000 non-eligibles and is inverted for others with a minimum at 1.2 doctors per 1,000 non-eligibles. It should be noted, however, that the difference for the quadratic responses should be treated with caution because of the extreme collinearity between a variable and its squared value.

Tables A-3 and A-4 present the mean values of the regression variables for continuous and other participants. The continuous participants are younger (the difference is statistically significant only in primary care) and are located in areas which are less expensive (employee wage, house value), which have more Medicaid patients per physician, and which have an older population. The continuous participants include more pediatricians and fewer internists than other participants. The physicians in the continuous group supply twice as many RVU's of service per quarter, a difference attributable to the number of patients they see rather than the extent of service per patient. Thus we see that physicians are likely to make greater contributions to the Medicaid program if they are located in areas with low costs and large numbers of Medicaid patients.

This hypothesis is supported by an examination of the proportion of physicians in the continuous and interrupted categories within individual counties. Map A-1 locates the ten counties for which this proportion is highest and the 10 for which it is lowest. The proportions of physicians in the various participation categories and other county data are listed in Table A-5. For the most part, the rural counties with high proportions of continuous and interrupted participants have many Medicaid eligibles per

TABLE A-3

Comparison of Regression Means for Continuous and All Other Participants Primary Care Physicians, California 1974-1978

	Continuous Participants		All Other Participants		t-value for
	Mean	Std. Deviation	Mean	Std. Deviation	H_o: $x_{cont.} - x_{oth.} = 0$
Total RVU	5963.3	8819.6	2855.5	6569.5	14.06*
RVU/patient	58.66	41.49	60.0	45.29	-1.02
Total Patients	114.47	163.01	51.9	100.04	16.82*
Billed Amount/RVU	.8323	.1998	.8483	.1991	-2.68*
Medicaid Allowed amt/RVU	.5746	.0734	.5758	.0744	-.541
Medicare Allowed amt/RVU	.6915	.1286	.7072	.1266	-4.12*
Per capital income	7138.5	1553.5	7284.1	1413.4	-1.18
% Black Students	9.58	7.80	8.57	7.27	1.61
% Spanish Students	16.02	8.32	15.49	6.87	0.84
% Aged	10.29	2.32	9.90	2.20	2.08*
% Unemployed	4.03	1.23	3.88	1.04	1.59
Non-aged eligibles/phys.	60.16	32.47	51.80	27.81	3.33*
Phys/non-eligible	.00240	.00121	.00251	.00109	-1.15
% Disabled	14.81	2.68	14.29	2.40	0.14
% AFDC	59.41	7.59	60.03	6.97	-1.02
% Needy	10.99	3.21	10.72	3.19	1.02
% Gen Prac.	15.61	8.34	13.85	6.29	2.87*
% Med. Spec.	15.33	3.45	15.37	2.91	-0.15
% Surg Sec.	19.74	3.15	19.48	2.49	1.10
Employee Wage ($000/qtr)	4.02	.9034	5.38	6.48	-3.54*
House Value ($000)	38.56	16.84	38.75	10.54	-0.16
Density	1322.7	3082.6	1319.0	2896.9	0.02
Experience	25.02	9.59	25.93	10.72	-2.93*
Int med binary	.2749	.4465	.3434	.4750	-4.91*
Ob-Gyn Binary	.1053	.3069	.1094	.3123	-0.44
Ped Binary	.0764	.2658	.0451	.2076	4.58*
	n = 3401		n = 1663		

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*Significant at the 5% confidence level. Degrees of freedom for area variables are based on the number of year-county combinations, rather than on the number of observations.

TABLE A-4

Comparison of Regression Means for Continuous and All Other Participants Surgical Specialties, California, 1974-1978

	Continuous Participants		All Other Participants		t-value for
	Mean	Std. Deviation	Mean	Std. Deviation	H_o: $x_{cont.} - x_{oth.} = 0$
Total RVU	4096.3	4603.2	1953.2	1968.6	13.92*
RVU/patient	80.0	48.3	82.2	56.1	-0.87
Total Patients	58.5	75.6	24.9	21.0	14.26*
Billed Amt/RVU	.9116	.2351	.9231	.2262	-1.05
Medicaid Allowed Amt/RVU	.5862	.0722	.5905	.0669	-0.17
Medicare Allowed Amt/RVU	.7353	.1417	.7515	.1383	-2.44*
Per Capita Income	7133.6	1615.2	7263.4	1494.1	-1.00
% Black Students	9.46	8.02	7.63	6.39	3.04*
% Spanish Students	16.02	8.90	14.61	6.77	2.15*
% Aged	10.56	2.46	9.80	2.48	3.71*
% Unemployed	4.01	1.22	3.75	0.954	2.86*
Non-aged eligible/phys.	59.67	30.56	50.26	26.07	3.99*
Phys./non-eligible	.00249	.00137	.00243	.000956	0.61
% disabled	14.91	2.63	14.19	2.33	3.49*
% AFDC	59.32	8.04	60.26	7.51	-1.45
% Needy	10.62	3.21	10.50	3.24	0.45
% Gen Prac.	14.43	6.28	13.49	5.91	0.28
% Med spec.	15.39	3.53	15.49	3.77	-0.33
% Surg. Spec.	20.13	3.54	19.76	2.87	1.38
Employee Wage ($000/qtr.)	3.923	.877	5.00	5.59	-3.24*
House Value ($000)	37.88	15.39	38.61	10.80	-0.66
Density	1495.7	3685.1	1057.5	2415.2	1.69
Experience	24.52	8.15	25.63	8.63	-1.59
Orth. Surg. Binary	.2588	.4382	.2364	.4251	1.10
	n = 1159			n = 715	

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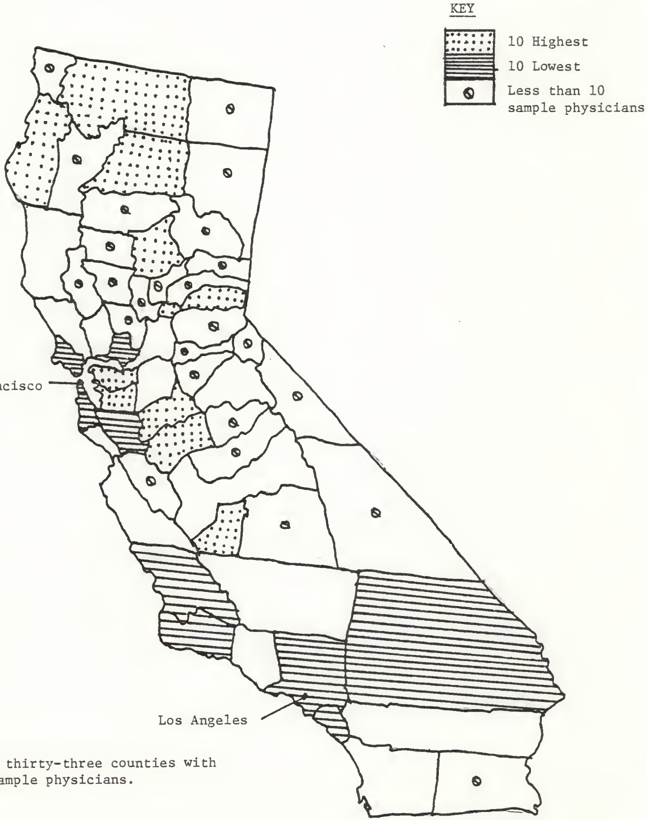
*Significant at the 5% confidence level. Degrees of freedom for area variables are based on the number of year-county combinations, rather than on the number of observations.

Map A-1

Location of Counties with 10 Highest and 10 Lowest Proportions of Major Participants[1]



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1. Based on the thirty-three counties with 10 or more sample physicians.

TABLE A-5
County Data for the 10 Highest and Lowest Counties Ranked by Proportion of Sample Physicians in Continuous or Interrupted Medicaid Practice[1]/

Counties	Sample Physicians	% Major Participants[2]	% Continuous Participants	% Drop Outs	% New Entries	1976 Non-Aged Eligibles/ Physician	1976 Non-Eligibles Physician	1976 Physicians per 1000 Population	1978 Billed Amt/RVU divided by Allowed Amt/RVU
A. Highest									
1. Siskiyou	11	90.9	6.4	0.0	0.0	92.73	1001.20	0.914	1.65
2. Contra Costa	131	87.7	26.7	5.3	1.5	48.43	518.13	1.766	1.51
3. Alameda	131	82.4	3.8	7.6	3.8	46.91	413.05	2.174	1.32
4. Stanislaus	54	81.4	72.2	9.3	0.0	90.06	527.43	1.438	1.51
5. Humboldt	26	80.8	61.5	15.4	0.0	75.17	550.06	1.600	1.58
6. Kings	10	80.0	80.0	20.0	0.0	163.88	1217.73	0.724	1.64
7. Butte	29	79.4	69.0	10.3	0.0	72.14	510.33	1.714	1.41
8. Merced	18	77.7	72.2	5.6	0.0	141.95	946.07	0.919	1.49
9. Shasta	34	76.5	64.7	14.7	0.0	69.48	523.29	1.687	1.49
10. Placer	17	76.4	58.8	5.9	11.8	60.17	610.50	1.491	1.84
B. Lowest									
10. San Francisco	143	48.9	34.3	6.3	4.9	25.03	143.88	5.918	1.54
9. Marin	99	46.6	29.3	13.0	2.0	11.67	260.48	3.674	1.51
8. Solano	52	46.1	44.2	5.8	1.9	81.37	884.17	1.036	1.62
7. San Bernardino	124	45.2	31.5	10.5	0.8	57.68	457.04	1.942	1.54
6. Santa Barbara	76	44.8	32.9	10.5	3.9	31.45	387.75	2.385	1.89
5. Santa Clara	114	44.8	0.0	9.6	4.4	34.85	386.35	2.374	1.48
4. San Luis Obispo	34	44.4	32.4	14.7	2.9	34.04	467.95	1.992	1.81
3. Los Angeles	611	41.7	29.5	5.6	4.7	46.42	369.14	2.406	1.88
PSRO 18	(69)	(39.2)	(23.2)	(7.2)	(2.9)				
PSRO 19	(66)	(37.9)	(24.2)	(7.6)	(1.5)				
PSRO 20	(96)	(40.6)	(32.3)	(5.2)	(5.2)				
PSRO 21	(55)	(31.0)	(27.3)	(14.5)	(1.8)	N.A.	N.A.	N.A.	N.A.
PSRO 22	(71)	(42.3)	(26.8)	(4.2)	(2.8)				
PSRO 23	(76)	(48.9)	(31.6)	(3.9)	(10.5)				
PSRO 24	(88)	(57.9)	(43.2)	(2.3)	(8.0)				
PSRO 25	(86)	(32.6)	(24.4)	(3.5)	(5.8)				
2. San Mateo	133	40.5	24.8	11.3	2.3	23.72	448.43	2.118	1.69
1. Orange	136	29.4	9.6	9.6	4.4	20.86	509.16	1.887	2.08

[1] Columns 1-5 and 9 based on sample data, 6-8 on published sources.

[2] Major participants encompass those physicians in Continuous or Interrupted Medicaid Practice.

N.A. = Not available.

physician and low private fees (represented by the billed amount per RVU) relative to Medicaid fees. The reverse is true for the urban, low-proportion counties in the vicinity of San Francisco and Los Angeles.

Two points are of interest: the high participation rates in counties with many Medicaid eligibles per physician implies that the gross physician to population ratio is a poor measure of Medicaid access because physicians in these areas serve more Medicaid patients than the average physician. This observation supports recent conclusions that physicians' supply decisions are responsive to the needs of the population in the area in which they are located and that simple "head counts" do not accurately measure the availablility of medical care.* The second point is that the ratio of billed amount per RVU had, by 1978, reached values higher than 1.8 in Placer, Santa Barbara, San Luis Obispo, Los Angles and Orange counties. Although these counties have relatively few Medicaid eligibles (less than 60 per physician compared to 75.5 for the average county) the large values suggest that the maintenance of a statewide fee schedule could result in future access problems in urban areas where physicians have high private fees. During the period under study increases in the number of physicians relative to the non-Medicaid-eligible population served to counterbalance the effects of rising input prices. There is, however, some evidence that the most urban areas are becoming "saturated" with physicians.* If the supply of physicians in these areas ceases to expand, future input cost increases may result in decreases in Medicaid participation which were not apparent during the study period.

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*See Hadley, Jack: Does Medical Care Affect Health? An Economic Analysis of Geographic Variations in Mortality Rates. Urban Institute Paptер No. 1225-7 July 1981; Aday, L.A.: Criteria for Determining Health Manpower Shortage Areas. In U.S. Department of Health, Education and Welfare, Health Resources Administration, Bureau of Health Manpower, Proceedings of the Workshop on Health Manpower Shortage Areas. Orlando, Florida, November 1976; Kleinman, J.C. and Wilson, R.W.: Are "medically underserved areas" medically underserved? Health Services Research 12:147, 1977; and Reinhart, F.E. and Held, P.J.: Health Manpower Policy in a Market Context. Paper presented at The Annual Meeting of The American Economic Association. Dallas, Texas, November 1979.

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*Fruen, Mary & Cantwell, James "Geographic Distribution of Physicians: Past Trends and Future Influences." _Inquiry_ forthcoming.

Appendix B: Econometric Issues

Time-series cross-section data, such as those used in this analysis, provide a wealth of information on individuals' behavior. This type of data also present several econometric problems. This appendix identifies the estimation problems inherent in a study of this type, reports the techniques used to counteract the possible biases and inefficiencies, and attempts to assess the stability of the results.

Three issues pertain to violation of the assumptions of ordinary least squares regression. The first is the simultaneous equation bias which can result if the endogenous variables in a model are jointly determined. The other two issues derive from the possibility that the error terms in the supply equations may not be randomly distributed across physicians within a given year (heteroskedasticity) or across years for a given physician (autocorrelation).

The binary characteristic of the dependent variable in the participation equation necessitates the use of a different estimation technique than that used for the continuous supply measures. The appropriate technique for this type of model is probit analysis.

The final issue pertains to the assumptions that the physician population is characterized by a single pattern of behavior which applies to all individuals. If groups of physicians exhibit systematic differences in their responses to variables in the model, the pooled parameter estimates are inefficent. In addition, it was necessary to impute price data for physicians who did not participate in Medicaid. If there are systematic differences across physicians, the price data imputed for nonparticipants may be biased.

Simultaneous Equation Bias

The theory underlying this study implies that private price--a physician's billed amount per RVU, and quantity--the number of Medicaid RVU's, are jointly determined. Hence, the errors for the participation and supply equations are correlated with the billed amount variable. This pattern of non-random errors can give rise to a biased estimate of the coefficient of the billed amount in the participation and supply equations. This problem can be corrected through the use of the predicted billed amount (obtained by regressing the actual billed amount on the exogenous variables) as an instrumental variable.* It should be noted that this first-stage equation should not be interpreted as a behavioral equation because no quantity variable appears on the right-hand side. Consequently, the coefficients are reduced form rather than structural, and reflect the indirect relation between the exogenous variables and quantity as well as the direct effects on price.

Table B-1 compares the ordinary least squares (OLS) and two-stage least squares (TSLS) estimates of the coefficients of the billed amount per RVU. The TSLS estimates are greater in magnitude for all six equations. Five of the six coefficients are more negative than the OLS estimates and all six have smaller relative standard errors. The reductions in standard errors suggests that, as hypothesized, the OLS estimates are biased and inefficient.

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* The exogenous variables used as regressors, which do not appear in the second stage equations, are: percent black students, percent hispanic students, percent of population over 64, the unemployment rate, the percentages of physicians in general practice, medical specialties and surgical specialties, per capita income and the Medicare allowed amount per RVU. The first eight of these variables are county-specific, the last is physician specific. Although the rates of change of some of these variables may be endogenous, it is assumed that the levels for a given year are exogenous. The R2's for the instrumental equations are 0.663 for the primary care specialties and 0.664 for the surgical specialties.

Table B-1.

A Comparison of the OLS and TSLS Estimates
of the Effect of Own Price on Physicians
Output Decisions

Dependent Variable	Coefficient and (Significance Level) OLS	TSLS
Total RVUs Per Quarter		
Primary Care	-1876.9 (0.01)	-3831.4 (0.01)
Surgeons	-396.9 (0.44)	-1478.1 (0.08)
RVUs Per Patient		
Primary Care	5.42 (0.11)	-13.78 (0.02)
Surgeons	10.13 (0.13)	-23.43 (0.03)
Medicaid Patients Per Participating Physician		
Primary Care	-51.44 (0.01)	-79.45 (0.01)
Surgeons	-4.81 (0.59)	-23.47 (0.08)

Heteroskedacity

Ordinary least squares regression, and by extension, instrumental variable regression techniques, assume that the errors in estimating the dependent variable in an equation reveal the effects of random factors which cannot be captured by the model itself. The error structure associated with estimation based on cross-sectional data, however, is frequently characterized by a correlation between the estimated errors and one or more of the independent variables. In this case the estimated coefficients are unbiased, but the estimated variances of the coefficients are biased downward, implying that the standard tests of significance are invalid. Traditionally, this problem is addressed by weighting each observation by the square root of a variable which serves as a proxy for the expected error.

In the analysis performed in this study, no attempt was made to correct for the existence of heteroskedasticity. The appropriate adjustments were not attempted for two reasons: at the level of our analysis--the individual physician--it is not clear which, if any, independent variables are likely to be correlated with the errors. This problem could be sidestepped (at considerable expense) by weighting by the square root of the predicted value of the dependent variable.

The second, and primary reason for not addressing the question of heteroskedacity is that the techniques mentioned above cannot be applied directly to estimates which may exhibit autocorrelation as well as heteroskedasticity.*

Autocorrelation

Autocorrelation is the time-series equivalent of heteroskedasticity, and is characterized by a non-random distribution of estimated errors across time for a given individual. The existence of autocorrelation, like heteroskedasticity, implies that the coefficients are unbiased, but that the standard errors are biased downward. The existence of gaps in the five-year series for individual physicians due to nonparticipation prohibits the computation of the usual Durbin-Watson d-statistic. We have, therefore, used two alternative approaches to attempt to assess the extent of autocorrelation. The first approach consists of reestimating the model equations using only data for 1975 and 1977. These two years bracket the year of the fee increase and thus should not impair the testing of the model. As long as the correlation of errors is strongest between adjacent years and does not apply to terms in the series separated by intervening years, the selection of these two years' data should sharply reduce the downward bias in the standard errors.

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* Both heteroskedasticity and autocorrelation could be addressed at once through the use of generalized least squares techniques if an estimate of the variance-covariance matrix of the errors, Ω could be made. In this analysis the appropriate matrix would contain "holes" because individual physicians must be excluded from the estimation procedure for the supply equations for the years in which they were nonparticipants. Because of this limitation, only modest attempts were made to assess the extent of non-random patterns in the errors.

Table B-2 compares the elasticities and t-ratios for estimates from the full sample to those based on 1975 and 1977 data only. For both the billed amount per RVU and physician-population ratio (the inverse of which was used here) all coefficients which are statistically significant in the full period sample are also significant in the restricted sample. For surgeons the allowed amount per RVU (Medicaid fee) is statistically significant for both samples in the total RVU equation and in that for patients per physician. In the primary care specialties, the allowed amount is not significant in the restricted samples. However, it was significant only in the patients per physician equation in the full sample. It is also reassuring to note that the elasticity estimates differ little between the two samples, in fact they are generally of larger magnitude in the restricted sample. Thus, although there does appear to be a slight downward bias in the standard errors due to autocorrelation, it does not seem to be large enough to invalidate the conclusions drawn from the estimates.

The second approach to the autocorrelation problem is to compute the modified d-statistic suggested by Savin and White.* This statistic is defined

$$d_* = \frac{\sum_{i}^{N} \sum_{t}^{T} (\hat{\varepsilon}_{i,t} - \hat{\varepsilon}_{i,t-1})^2}{\sum_{i}^{N} \sum_{t}^{T} (\hat{\varepsilon}_{i,t})^2}$$

N = number of physicians

T = number of years

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* N.E. Savin and Kenneth J. White, "Testing for Autocorrelation with Missing Observations." Econometrica, Vol. 46, No. 1 (January 1978):59-67

Table B-2.

A Comparison of Elasticity Estimates
and (T-Ratios)1/ for Five Years
and Two Selected Years

Parameter	Sample 1974-1978	 1975 & 1977 only
A. Primary Care Physicians		
Total RVUs		
Own Price	-0.75 (-3.38)	-0.76 (-2.01)
Medicaid Fee	0.63 (1.64)	0.39 (0.60)
Non-eligibles/Physicians	-0.56 (-5.03)	-0.61 (-3.42)
RVUs Per Patient		
Own Price	-0.24 (-2.93)	-0.29 (-2.12)
Medicaid Fee	0.11 (0.75)	0.31 (1.32)
Non-eligibles/Physicians	-0.06 (-1.41)	-0.06 (-0.85)
Patients/Physician		
Own Price	-0.81 (-3.88)	-0.92 (-2.59)
Medicaid Fee	0.74 (2.06)	0.49 (0.82)
Non-eligibles/Physicians	-0.58 (-5.52)	-0.67 (-3.96)
Number of Observations	4749	1969
B. Surgeons		
Total RVUs		
Own Price	-0.42 (-1.78)	-0.69 (-1.84)
Medicaid Fee	1.09 (2.43)	1.91 (2.11)
RVUs Per Patient		
Own Price	0.27 (2.15)	0.35 (1.85)
Medicaid Fee	-0.58 (-2.45)	-0.53 (-1.45)
Patients/Physician		
Own Price	-0.47 (-1.70)	-0.73 (-1.74)
Medicaid Fee	1.47 (2.84)	1.90 (2.32)
Number of Observations	1858	785

Note: 1. T-ratios are for estimated regression coefficients. Elasticities are evaluated at the sample means.

using all pairs of years, t and t-1, for which errors can be estimated. It should be noted that the computation of a single statistic forces the estimate of the autocorrelation coefficient ρ, to be the same for all physicians.

Our estimates of d_*, presented in Table B-3, are seen to range from 0.26 to 1.24. The d_* statistics are lower (indicating more serious autocorrelation) in the primary care equations, and highest in the RVU's per patient equation. The values are clearly below the bounds of statistical significance for positive correlation (which are broader for this statistic than for the standard d-statistic). These numbers should, however, be interpreted less strictly than the traditional d-statistics because the method of computation excludes information on the estimated errors for years preceded or followed by non-participation, and hence are based on the years most likely to exhibit autocorrelation. The estimates presented above for the two-year sample suggest that the degree of autocorrelation may be less than that indicated by the d_* statistics.

Table B-3.

Estimated D_* Statistics for Output Equations

Specialty and Dependent Variable	D_* Statistic
Primary Care	
RVU's/quarter	0.32
RVU's/patient	0.83
Patients/quarter	0.26
Surgery	
RVU's/quarter	0.87
RVU's/patient	1.24
Patients/quarter	1.06

Probit Analysis

The binary dependent variable in the participation equations represents the observed result of a choice made by a given individual physician--either he/she participates in Medicaid or he/she does not. It seems logical, however, that some physicians are more likely to participate than others and that the probability of participation varies within the two groups defined by observed participation status as well as between participants and non-participants. It is this probability of participation that our model attempts to estimate.

The probabilities to be estimated are clearly constrained to the interval between 0 and 1, while the explanatory variables are, for the most part, continuous. A simple linear regression model would generate predicted probabilities which have an infinite range whereas the true dependent variable has a bounded range. The predicted errors would be heteroskedastic, with the largest (in magnitude) errors occurring in the middle of the range of valid values (0.5) and above and below the valid range (less than 0 or greater than 1).

The probit technique uses a two-part function based on the cumulative normal distribution to estimate a probability function which obeys the necessary constraints. The first part of the function defines an index, I, which is a linear function of all the explanatory variable values. The coefficients of the function are expected to be negative for variables which inhibit participation, e.g., predicted billed amount per RVU, house value; and positive for variables which encourage participation, e.g., the ratio of physicians to non-eligibles, the Medicaid allowed amount. Large values of the index are associated with higher probabilities of participation and vice versa. Because the index is a linear function of the explanatory values it has an infinite range and cannot be used directly to predict the probabilities of participation.

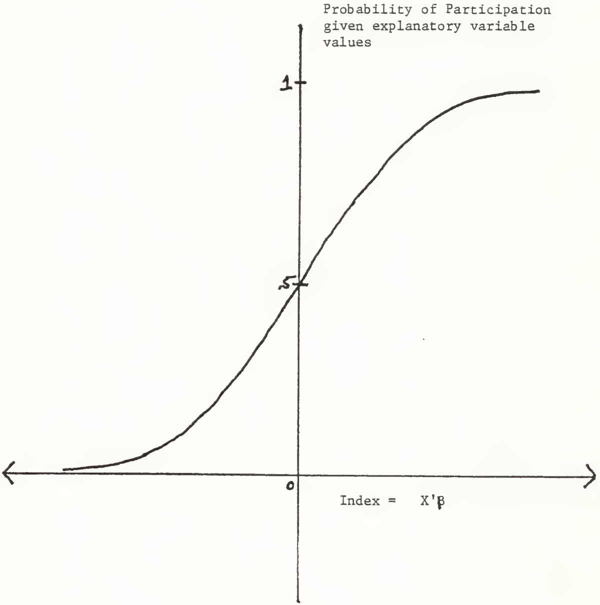
The second part of the probit function serves to transform the index into an estimator which is limited to the 0-1 interval. This estimator is defined as the value of the cumulative normal distribution function evaluated at the level of the index I. In this way, the value of the index for any given physician is similar to the z-scores commonly used with normal distributions. The estimated probability function has the general form illustrated in Figure B-1. The vertical axis represents the probability of participation. The horizontal axis registers index values which incorporate all the explanatory variables.

As is evident in the illustration, the slope of the probability function is not constant. It is near zero for probabilities near the bounds of the 0-1 interval. The slope, and hence, the effect of a change in an explanatory variable, is greatest when the index is near 0 and the corresponding probability near 0.5. As the index becomes larger (as we move from left to right in the illustration) the probability of participation increases slowly at first, then more rapidly, and then again slowly.

The relation between the index value and the explanatory variables has two important characteristics. Because the index represents the sum of the products of the variables and their coefficients, many combinations of explanatory values will give the same index value, and indirectly the same probability of participation. For example, the estimated coefficient on the internal medicine binary in the primary care equation is -0.435. The coefficient on the allowed amount is 1.37. Therefore, an allowed amount which is 0.4535/1.37 or $0.32 per RVU higher serves to offset the disincentives inherent in being an internist.

Figure B-1

The Probit Probability Function



These "tradeoffs" based solely upon the estimated index coefficients apply to all physicians. The change in the probability of participation with respect to the change in a single explanatory variable, however, is not constant. The change and hence the elasticity depends on the levels of *all* the explanatory variables as incorporated in the index function. The effects of a given change can vary between physicians. This is simply a reflection of the non-linear, two-part nature of the function being estimated. The analysis in Chapter IV reports the index coefficients of the probability function. The elasticities reported are based on the derivatives of the probability function at the sample means. These derivatives are the slope of the function assuming that all variables other than that chosen for evaluation are held constant at the sample means.* The derivatives at this point are approximately equal to the reported coefficients multiplied by a factor of 0.4.

The probit analysis used to estimate the particpation equations is more complicated, and its results somewhat more difficult to interpret than those of the alternative, least squares analysis. The technique is, however, designed specifically for the evaluation of models with binary dependent variables. Because the nonlinear function estimated generates only valid probabilities, the estimated standard errors are much more accurate than those derived from a linear model. This implies that the conclusions based on these results are less subject to error than which could have been obtained using linear model.

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* Formally,

$$\frac{\partial(Y|\ I)}{\partial X_k} = \beta_k * f(I)$$

where Y = 1 for a participant, and zero otherwise and

$$f(\alpha) = \frac{1}{\sqrt{2\ \pi}} * e^{-\frac{1}{2}\ \alpha^2}$$

The β_k were estimated using a maximal likelihood procedure.

Homogeneity of the Sample

As reported in Appendix A, there is some evidence that physicians who participate in Medicaid intermittently behave differently from those who participate continuously. The hypotheseis that the two subsamples are members of the same population was rejected for all of the supply equations and significant differences were found in the mean values of most independent variables for the two groups. The sample separation for this comparison was, however, determined by the values of dependent rather than independent variables and thus may not represent a true case of heterogeneity. It seems more likely that the differences observed reflect the existence of nonlinearities in the response to model variables. This hypothesis is supported by the fact that most of the significant differences in coefficients appear in the quadratic responses to years of experience and the physician population ratio. In both these cases the estimated relationship is clearly nonlinear, but the exact form is difficult to estimate because of the correlation between the original and squared variables. In any case, the existence of heterogeneity may reduce the efficiency of estimation but should not bias the estimated coefficients.

Possible differences between participants and nonparticipants are of real concern only for the imputation of billed and allowed amounts per RVU for nonparticipants for use in the participation equations. These amounts were imputed as follows:

(1.) If the Medicaid billed amount per RVU were missing the first nonmissing value found from the choices below was used (all physician-specific):

a) the Medicare billed amount per RVU for the current year.

b) the ratio of the Medicaid billed amount per RVU to the county average for the next year times the current year county average.

c) the corresponding ratio and product using the Medicare billed amount per RVU for the next year.

d) the Medicaid ratio and product from the previous year.

e) the Medicare ratio and product from the previous year.

f) the rest of this series for the remaining years with Medicaid billed amounts retaining priority over Medicare billed amounts and the nearest future year retaining priority over the nearest previous year

g) if no value for Medicaid or Medicare billed amounts were found in the five year period the value was set to the current year county average.

(2.) Medicaid allowed amounts were assigned using the same heirarchical structure of choice based only upon values of Medicaid allowed amounts.

(3.) Medicare allowed amounts (used as a regressor in predicting billed amounts) were assigned in the same way using only Medicare allowed values.

Although this method of imputing missing data is, of necessity, somewhat arbitrary, it does make full use of all information available for each physician. At the same time, the preference given to future years over prior years should serve to counteract the effects of generally positive differences between the nonparticipants billed amount and those for participants.

Summary

Within the restrictions imposed by the data itself, and to a lesser extent by cost considerations, we have attempted to assess and when possible correct for inefficiencies resulting from non-random error distributions likely to be present in this type of data. Autocorrelation does not apear to present serious problems, and the extent of heteroskedasticity is unknown. The use of instrumental techniques removes simultaneous equation bias and probit techniques were used when appropriate. In summary, although the data present possible problems, our investigations do not raise any serious questions about the validity of the results or the conclusions made from the estimates.

APPENDIX C

MISCELLANEOUS STATISTICAL TABLES

TABLE C-1

BILLED AMOUNT PER RELATIVE VALUE UNIT EQUATIONS
(First Stage Equations)

	Primary Care		Surgery	
	(y = .8376)		(y = .9160)	
Independent Variable	Coefficient	t-value	Coefficient	t-value
Intercept	-.3332	-4.85	-.674	.119
Per Capita Income	6.18×10^{-7}	.272	5.63×10^{-6}	1.37
Percent of Students: Black	.0231	.487	-.444	-5.04
Hispanic	.0260	.867	.0302	.581
Percent of Population: over 64	-.0217	-.189	-.036	-.166
unemployed	.193	.808	.0155	.034
Non-aged eligibles per Phys.	2.21×10^{-4}	1.62	3.36×10^{-4}	1.34
Phys. per non-eligible pop.	-2.80	-2.22	-5.94	-.244
Phys. Per non-eligible pop. sq.	4077	2.32	-1327	-.406
Percent of Eligibles: Disabled	.408	4.40	.512	2.90
AFDC	-.0230	-.434	.0165	.196
Needy	.00217	.019	-.0128	-.062
Percent of Phys.: Gen. Practice	-.0270	-.465	-.0381	-.285
Med. Spec.	.0162	.194	.063	.478
Surg. Spec.	-.00185	-.018	.102	.597
Medicaid Allowed Amt/RVU	.8352	21.43	1.03	14.24
Medicare Allowed Amt/RVU	.9463	50.86	1.11	33.04
Phys. Employees Salaries	4.72×10^{-4}	1.05	-.00179	-1.95
Average House price	-9.75×10^{-5}	-.668	-9.51×10^{-4}	-2.80
Population per sq. mile	-7.01×10^{-6}	-2.45	1.01×10^{-5}	1.94
Experience	-4.88×10^{-4}	-.645	.00708	3.50
Experience Squared	-5.6×10^{-6}	-.425	-1.27×10^{-1}	-3.34
Internist Binary	.0114	2.89	NA	NA
OB-Gyn Binary	.0327	5.83	NA	NA
Pediatrician Binary	-.0447	-6.54	NA	NA
Orth. Surgeon Binary	NA	NA	-.00911	-1.24
1975 Binary	.0284	4.32	.00818	.653
1976 Binary	.0899	12.58	.0906	6.58
1977 Binary	-.00348	-.368	-.0370	-2.05
1978 Binary	-.0178	-1.66	-.0741	-3.60
F	352.91		140.40	
R^2	0.663		0.664	
D.F.E.	5035		1847	

Table C-2

Total Price Elasticities (With and Without A Time Effect) Of Physician Supply Of Medicaid Services, California, Solo Practice, 1978[a]

		Physicians, By Specialty					
		Primary Care			Surgery		
Supply Parameter	Price	W-Year Binary	W/O-Year Binary	Mean	W-Year Binary	W/O-Year Binary	Mean
A. Probability of Participation in the Medicaid program	Private	-1.04	-0.79	-0.92	-0.99	-0.75	0.87
	Medicaid	0.02	0.09	0.06	1.14	1.13	1.14
B. Medicaid Quantity (Given Participation)							
1. Total RVUs per Quarter	Private	-0.65	-0.42	-0.54	-0.41	-0.32	-0.37
	Medicaid	0.19	0.43	0.31	0.64	0.76	0.70
2. RVUs per Patient	Private	-0.20	-0.20	-0.20	0.27	0.28	0.27
	Medicaid	-0.09	-0.50	-0.30	-0.38	-0.50	-0.38
3. Patient per Physician	Private	-0.71	-0.45	-0.58	-0.47	-0.48	-0.47
	Medicaid	0.21	0.88	0.55	0.98	1.14	1.06

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[a] The Medicaid price elasticities include the direct and indirect effect of the Medicaid price. The latter are estimated from the structural equations and assume that the private market in the long run adjusts their demand schedule to fully offset the increase in private price which was brought about by the increase in Medicaid prices.

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